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CLOSURE ASSESSMENT REPORT RETAIL FUEL DISTRIBUTION FACILITY BUILDING #1346 CNC CHARLESTON SC

4/8/1991

WESTINGHOUSE ENVIRONMENTAL AND GEOTECHNICAL SERVICES, INC.

CLOSURE ASSESSMENT REPORT
RETAIL FUEL DISTRIBUTION FACILITY
BUILDING #1346
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

Prepared for:

The LPA Group of North Carolina
38303 B Computer Drive, Suite 204
Raleigh, North Carolina 27619

Prepared by:

Westinghouse Environmental
and Geotechnical Services, Inc.
840 Low Country Boulevard
Mount Pleasant, South Carolina 29464
(803) 884-0005

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DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090
Code 1849
2 Feb 00

South Carolina Department of Health and Environmental Control
Attn: Mr. Paul Bristol
Groundwater Quality Section
Bureau of Water
2600 Bull Street
Columbia, SC 29201

CLOSURE ASSESSMENT REPORT – RETAIL FUEL DISTRIBUTION FACILITY, BUILDING #1346

Dear Mr. Bristol:

Enclosed is the original of the Closure Assessment Report – Retail Fuel Distribution Facility, Building #1346, Charleston Naval Base, Charleston, SC that was borrowed from SCDHEC files. Thanks again for your assistance.

Sincerely,

GABRIEL L. MAGWOOD
Remedial Project Manager

Encl:
(1) Closure Assessment Report

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Westinghouse Environmental and Geotechnical Services, Inc.

840 Low Country Boulevard
P.O. Box 1551
Mt Pleasant, South Carolina 29464
(803) 884-0005
Fax (803) 881-6149

March 26, 1991

The LPA Group of North Carolina
3803 B Computer Drive, Suite 204
Raleigh, North Carolina 27619

Attention: Mr. Gary Green

Subject: Closure Assessment Report
Building #1346, Charleston Naval Base
Charleston, South Carolina
Westinghouse Environmental and Geotechnical Services, Inc.
Job #CSWA079

Dear Mr. Green:

Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) is pleased to submit the enclosed Closure Assessment Report for the retail fuel distribution facility, Building #1346 located at the Charleston Naval Base in Charleston, South Carolina. This report is provided in general accordance with our proposal number 340-91-024 dated February 20, 1991. The following report describes our sampling methodology, the analytical results and our conclusions and recommendations.

If you have any questions concerning this report or if you require any additional information, please contact Hugh Connolly at (803) 884-0005.

Sincerely,

WESTINGHOUSE ENVIRONMENTAL
AND GEOTECHNICAL SERVICES, INC.

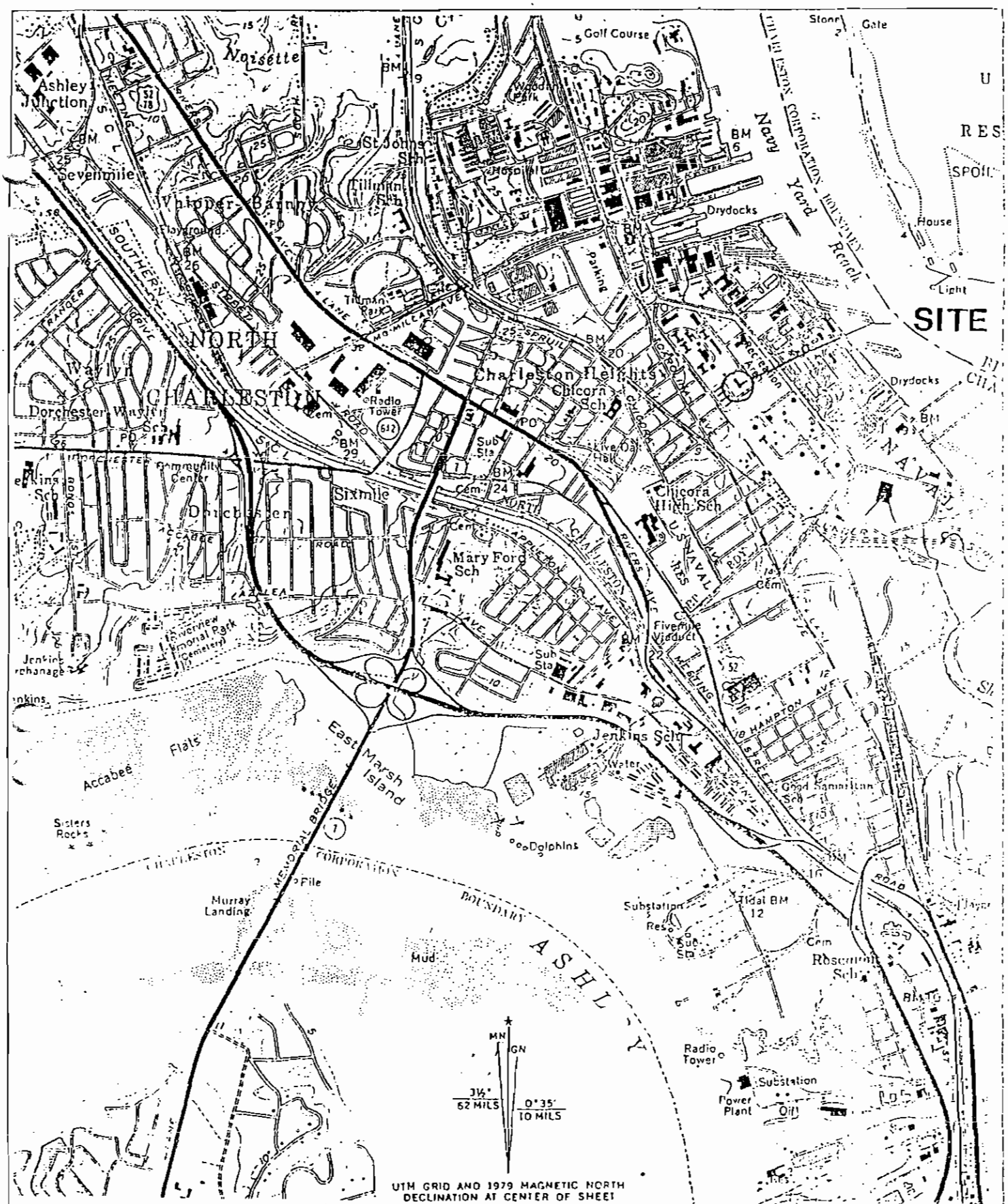
Hugh Connolly
Project Hydrogeologist

Sonny Chestnut, P.E.
Senior Environmental Engineer

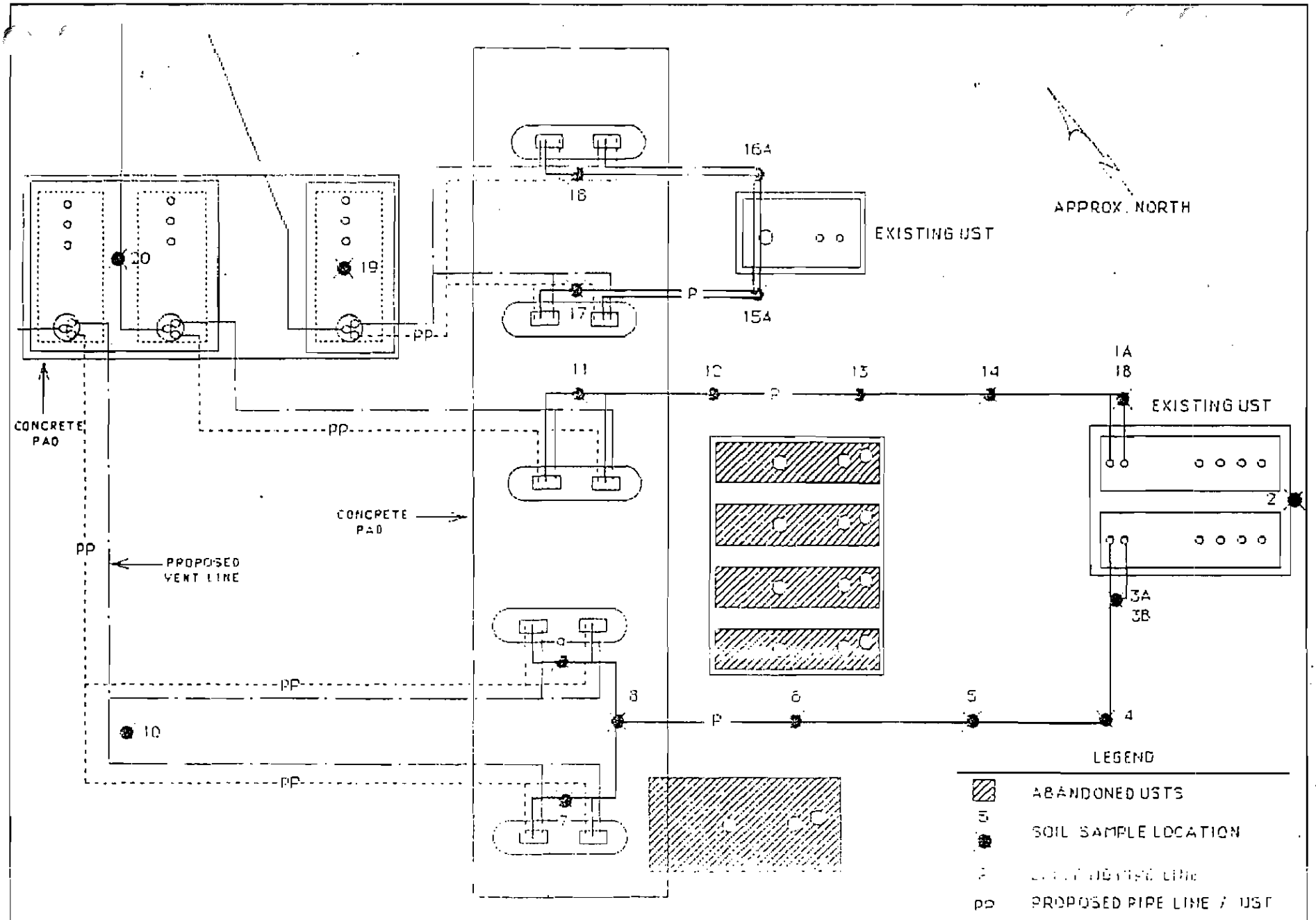
1.0 INTRODUCTION

The study site is identified as Building #1346 at the Charleston Naval Base and is a retail automotive gasoline service station (Figure 1). The site presently possesses a total of 8 gasoline Underground Storage Tanks (USTs), 3 of which were recently operational. In 1978, four 1,000 gallon and one 10,000 gallon gasoline USTs were taken out of service and were abandoned in place. This involved internal cleaning of the tanks and filling with sand. The site was then fitted with three new gasoline USTs of 10,000 gallon capacity that have been operational until early 1991.

In February of 1991, the three 10,000 gallon gasoline USTs were tested for tightness. The results of the testing indicated that all three USTs were leaking and as a result they were immediately taken out of service. Presently, the site is scheduled to be fitted with three new USTs. These USTs and associated product piping will be located on the opposite side of the site relative to the existing USTs to minimize the amount of expected contaminated material encountered upon installation. A site plan depicting the various UST locations is presented as Figure 2.



SCALE: 1:24000	DRAWN BY: CWM	Westinghouse Environmental and Geotechnical Services, Inc.	TITLE: SITE PLAN BUILDING 1346 CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA
DATE: 3-18-91	CHECKED BY:	840 Low Country Boulevard Mt. Pleasant, South Carolina 29646 (803) 884-0005	FIGURE 1
JOB NO: 1234-89-483	APPROVED BY:		



SCALE: 1" = 20'	DRAWN BY: [illegible]	Westinghouse Environmental and Geotechnical Services, Inc.	TITLE: SITE SAMPLING PLAN BUILDING 1346 CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA	FIGURE 2
DATE: 3-19-91	CHECKED BY: HSC			
JOB NO: [illegible]	APPROVED BY: HSC			

2.0 OBJECTIVE AND SCOPE OF WORK

Westinghouse was retained to provide soil sampling and analysis to assess the subsurface soils at the site that may have been impacted due to the leaking USTs and to aid in determining if the groundwater at the site may have been impacted.

In compliance with Section 280.72 of the South Carolina Underground Storage Tank Control Regulations, Westinghouse conducted a site assessment at Building #1346 of the Charleston Naval Base. This assessment was conducted in accordance with the South Carolina Department of Health and Environmental Control's (SCDHECs) Underground Storage Tank Abandonment/Assessment Guidelines dated December 5, 1990, requiring that soil samples be collected within the tank basins and at 20' intervals along product piping runs.

2.1 Site Inspection/Sampling and Laboratory Analyses

On February 25, 1991, Westinghouse personnel arrived on site to mark the sample locations and perform a visual inspection of the site. No apparent problem areas were noted during the inspection and the UST fill locations, dispenser islands and vent lines did not visibly indicate the presence of a release.

Plans provided by the Charleston Naval Base were utilized to approximate the locations of the product piping. The exact locations were then determined by utilizing a hand held metal detector. A total of 20 sample locations were marked at the site. Sample numbers 1B, 2 and 3B were intended to be lower level samples collected from the bottom of the tank basin; however, groundwater was encountered in these areas at a depth of 5 feet below grade and the samples were therefore collected at this depth.

The remaining samples were collected adjacent to product lines between the USTs and the retail issue points at a depth of 3 feet below grade. Lower level samples were to be collected from the base of the UST associated with sample numbers 15A and 16A; however, due to the shallow depth at which groundwater was encountered (3.5 feet below grade), the deeper samples were not collected.

Three additional soil samples were collected from the location of the proposed product piping and UST locations situated on the opposite side of the site from the existing USTs. This was performed to determine if the soils in the area of the proposed tanks and product piping were contaminated. Sample number 10 was collected from a proposed product piping area at a depth of 3 feet below grade . Sample numbers 19 and 20 were collected from the area of the proposed UST basins at a depth of 5 feet below grade (at the soil/groundwater interface).

One groundwater sample was to be collected from an open borehole at each of the existing USTs basins; however, borehole collapse at the soil groundwater interface would not permit the collection of these samples.

Prior to and in between each sample collected, the sampling equipment was decontaminated with a chemically neutral surfactant and was rinsed a minimum of three times with deionized water. Upon collection, the samples were labeled and immediately refrigerated. Once sample collection had been completed, all samples were shipped by overnight courier to Westinghouse's in-house Laboratory in Charlotte, North Carolina for analysis. All samples collected at the site were analyzed for Total Petroleum Hydrocarbons (TPH) by Gas Chromatography (GC), the EPA Method 602 constituents and total lead.

2.2 Laboratory Analysis Results

Lead was not detected in any of the soil samples collected from Building #1346; however varying levels of petroleum hydrocarbon contamination were detected in all samples. Table 1 summarizes the results of the laboratory analyses.

TABLE 1

SUMMARY OF LABORATORY ANALYSES
BUILDING #1346 - CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

SAMPLE #	TPH BY GC (mg/kg)	EPA METHOD 602 CONSTITUENTS (µg/kg)							
		BENZENE	CHLORO-BENZENE	1, 2-DICHLORO-BENZENE	1, 3-DICHLORO BENZENE	1, 4-DICHLORO-BENZENE	ETHYLBENZENE	TOLUENE	XYLENE
NAVUST-1A	1210	11.6	339	428	65.2	33.3	156	198	2950
NAVUST-1B	217	1790	74.6	228	40.5	20.7	BQL*	658	5250
NAVUST-2	253	306	186	267	34.3	26.3	BQL	1880	4160
NAVUST-3A	455	16.1	153	378	42.2	33.9	1370	211	7010
NAVUST-3B	2250/93.6**	531	89.6	159	29.6	20.1	49.7	876	2030
NAVUST-4	114	210	36.7	312	55.8	46.9	BQL	4190	6000
NAVUST-5	1560	35.0	52.5	485	57.8	51.4	2040	355	5920
NAVUST-6	283	157	22.0	485	57.8	51.4	526	1040	3160
NAVUST-7	7280	1590	1190	268	50.1	34.3	BQL	174	6930
NAVUST-8	67.6	389	38.9	464	161	15.3	2120	132	475
NAVUST-9	55.1	3390	13.2	249	100	6.4	550	52.8	245
NAVUST-10	33.7	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
NAVUST-11	202	78.3	32.0	406	212	8.38	134	43.1	128
NAVUST-12	3720	161	77.1	89.1	19.0	12.9	BQL	754	7220
NAVUST-13	25.5	85.6	6.77	117	36.2	BQL	150	20.0	300
NAVUST-14	19.8	BQL	BQL	BQL	BQL	BQL	BQL	8.9	8.6
NAVUST-15A	5460	1880	193	134	35.9	25.7	BQL	3200	18,200
NAVUST-16A	3400/109	5750	36.4	114	19.0	15.6	BQL	11.500	1350
NAVUST-17	731	2690	24.6	513	273	13.5	BQL	735	1480
NAVUST-18	96.6	2580	13.7	396	150	18.5	2310	65.7	1360
NAVUST-19	30.5	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
NAVUST-20	38.3	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

NOTES: * BQL - INDICATES PARAMETER NOT DETECTED. ** - 3B AND 16A UNDERWENT ADDITIONAL ANALYSES FOR VOLATILE HYDROCARBONS FOR COMPARISON PURPOSES.

3.0 CONCLUSIONS/RECOMMENDATIONS

Various levels of petroleum hydrocarbon contamination were detected in all samples collected from Building #1346 at the Charleston Naval Base indicating that a significant release has occurred from the subject USTs. The laboratory results obtained indicate that this release has impacted the soils associated with the UST basins, product piping and retail issuing points. In addition to these areas, it has been found that contamination has migrated to the area of the proposed UST basin as was identified in sample numbers NAVUST-10, NAVUST-19 and NAVUST-20.

Westinghouse recommends the subject USTs that have failed to meet South Carolina State requirements for tank tightness testing be abandoned according to the SCDHEC regulations (either abandoned in place or removed). Any soil resulting from the abandonment of the USTs should be considered contaminated and should be stockpiled on-site, sampled and analyzed for petroleum related constituents to determine the proper method for disposal.

Based upon levels of contamination detected in sample numbers 1B, 3B, 15A and 16A (collected at the soil groundwater interface) it is probable that the groundwater in the areas has been impacted. This impact may or may not have migrated across and/or off of the gasoline service station site. With regard to the installation of the proposed USTs and pipelines at the site, the soil resulting from this operation should be considered to be contaminated. However, based upon the lower levels of contamination detected in the proposed tank basin and piping trenches, this material should be stockpiled separately, sampled and analyzed to determine the method for proper disposal. Based on the results identified in this assessment, it is probable that the soil excavated in the area of the new tanks will contain minimal contamination and will only require landfilling as opposed to incineration which is normally required for soils contaminated with TPH in excess of 100 mg/kg. Due to the fact that groundwater at the site has been impacted, any groundwater resulting from dewatering operations for the installation of the proposed USTs should be considered contaminated and should be handled appropriately.

In addition to the previous recommended work, Westinghouse recommends that a site characterization be performed to determine the horizontal and vertical extent of the probable groundwater impact. This would involve performing an extensive soil vapor survey across the site and the installation of groundwater monitoring wells to confirm the location of the dissolved product plume. Aquifer testing will also be required to determine the hydraulic aquifer characteristics. This information could then be utilized to design a groundwater recovery system for site remediation.

APPENDIX I

LABORATORY ANALYSIS DATA SHEETS

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
P.O. Box 7668
Charlotte, North Carolina 28241-7668
(704) 523-4726
FAX (704) 525-3953

Lead, Total in Soil

Westinghouse Environmental Job No: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484)

Date Analyzed: 3/5/91 Analyst: Ty Garber

Sample I.D.	Quant. Limit, mg/kg	Results mg/kg
NAVUST-1A	5.0	BQL
NAVUST-1B	5.0	BQL
NAVUST-2	5.0	BQL
NAVUST-3A	5.0	BQL
NAVUST-3B	5.0	BQL
NAVUST-4	5.0	BQL
NAVUST-5	5.0	BQL
NAVUST-6	5.0	BQL
NAVUST-7	5.0	BQL
NAVUST-8	5.0	BQL
NAVUST-9	5.0	BQL
NAVUST-10	5.0	BQL
NAVUST-11	5.0	BQL
NAVUST-12	5.0	BQL
NAVUST-13	5.0	BQL
NAVUST-14	5.0	BQL
NAVUST-15A	5.0	BQL
NAVUST-16A	5.0	BQL
NAVUST-17	5.0	BQL
NAVUST-18	5.0	BQL
NAVUST-19	5.0	BQL
NAVUST-20	5.0	BQL

Comments: EPA SW-846 Method 3050 used in digestion. Samples analyzed by flame AA.

BQL = Below Quantitation Limit

QA/QC Supervisor: _____ Date: 3/7/91

N.C. Wastewater #321, S.C.D.H.E.D. #99033

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
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(704) 523-4726
FAX (704) 525-3953

Total Petroleum Hydrocarbons

Westinghouse Job No.: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484)

Date Analyzed: 3/5/91 By: Ty Garber

	Semi-Volatiles		Volatiles	
Sample ID	Quant. Limit mg/kg	Results mg/kg	Quant. Limit mg/kg	Results mg/kg
NAVUST-1A	10.0	1,210	0.1	N/A
NAVUST-1B	10.0	217	0.1	N/A
NAVUST-2	10.0	253	0.1	N/A
NAVUST-3A	10.0	455	0.1	N/A
NAVUST-3B	10.0	2,250	0.1	93.6
NAVUST-4	10.0	114	0.1	N/A
NAVUST-5	10.0	1,560	0.1	N/A
NAVUST-6	10.0	283	0.1	N/A
NAVUST-7	10.0	7,280	0.1	N/A
NAVUST-8	10.0	67.6	0.1	N/A
NAVUST-9	10.0	55.1	0.1	N/A
NAVUST-10	10.0	33.7	0.1	N/A
NAVUST-11	10.0	202	0.1	N/A
NAVUST-12	10.0	3,720	0.1	N/A
NAVUST-13	10.0	25.5	0.1	N/A
NAVUST-14	10.0	19.8	0.1	N/A
NAVUST-15A	10.0	5,460	0.1	N/A
NAVUST-16A	10.0	3,400	0.1	109
NAVUST-17	10.0	731	0.1	N/A
NAVUST-18	10.0	96.6	0.1	N/A
NAVUST-19	10.0	30.5	0.1	N/A
NAVUST-20	10.0	38.3	0.1	N/A

Comments:

Semi-Volatile analysis: Extraction (SW-846, Method 3550); results expressed as mg diesel fuel per kg soil. Components exhibit characteristics similar to gasoline.

Volatile analysis: Purge and Trap (SW-846, Method 5030); results expressed as mg gasoline per kg soil.

BQL = Below Quantitation Limit N/A = Not Applicable

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-1A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	11.6
2	Chlorobenzene	5.0	339
3	1,2-Dichlorobenzene	5.0	428
4	1,3-Dichlorobenzene	5.0	65.2
5	1,4-Dichlorobenzene	5.0	33.3
6	Ethylbenzene	5.0	156
7	Toluene	5.0	198
8	Total Xylenes	5.0	2950

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-18

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1790
2	Chlorobenzene	5.0	74.6
3	1,2-Dichlorobenzene	5.0	228
4	1,3-Dichlorobenzene	5.0	40.5
5	1,4-Dichlorobenzene	5.0	20.7
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	658
8	Total Xylenes	5.0	5250

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-2

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	306
2	Chlorobenzene	5.0	186
3	1,2-Dichlorobenzene	5.0	267
4	1,3-Dichlorobenzene	5.0	34.3
5	1,4-Dichlorobenzene	5.0	26.3
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	1880
8	Total Xylenes	5.0	4160

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-3A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	16.1
2	Chlorobenzene	5.0	153
3	1,2-Dichlorobenzene	5.0	378
4	1,3-Dichlorobenzene	5.0	42.2
5	1,4-Dichlorobenzene	5.0	33.9
6	Ethylbenzene	5.0	1370
7	Toluene	5.0	211
8	Total Xylenes	5.0	7010

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-3B

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	531
2	Chlorobenzene	5.0	89.6
3	1,2-Dichlorobenzene	5.0	159
4	1,3-Dichlorobenzene	5.0	29.6
5	1,4-Dichlorobenzene	5.0	20.1
6	Ethylbenzene	5.0	49.7
7	Toluene	5.0	876
8	Total Xylenes	5.0	2030

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-4

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	210
2	Chlorobenzene	5.0	36.7
3	1,2-Dichlorobenzene	5.0	312
4	1,3-Dichlorobenzene	5.0	55.8
5	1,4-Dichlorobenzene	5.0	46.9
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	4190
8	Total Xylenes	5.0	6000

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

Westinghouse Environmental
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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-5

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	35.0
2	Chlorobenzene	5.0	52.5
3	1,2-Dichlorobenzene	5.0	465
4	1,3-Dichlorobenzene	5.0	57.8
5	1,4-Dichlorobenzene	5.0	51.4
6	Ethylbenzene	5.0	2040
7	Toluene	5.0	355
8	Total Xylenes	5.0	5920

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-6

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	157
2	Chlorobenzene	5.0	22.0
3	1,2-Dichlorobenzene	5.0	485
4	1,3-Dichlorobenzene	5.0	57.8
5	1,4-Dichlorobenzene	5.0	51.4
6	Ethylbenzene	5.0	526
7	Toluene	5.0	1040
8	Total Xylenes	5.0	3160

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-7

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1590
2	Chlorobenzene	5.0	1190
3	1,2-Dichlorobenzene	5.0	268
4	1,3-Dichlorobenzene	5.0	50.1
5	1,4-Dichlorobenzene	5.0	34.3
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	174
8	Total Xylenes	5.0	6930

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
P.O. Box 7668
Charlotte, North Carolina 28241-7668
(704) 523-4726
FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-8

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	389
2	Chlorobenzene	5.0	38.9
3	1,2-Dichlorobenzene	5.0	464
4	1,3-Dichlorobenzene	5.0	161
5	1,4-Dichlorobenzene	5.0	15.3
6	Ethylbenzene	5.0	2120
7	Toluene	5.0	132
8	Total Xylenes	5.0	475

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-9

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	3390
2	Chlorobenzene	5.0	13.2
3	1,2-Dichlorobenzene	5.0	249
4	1,3-Dichlorobenzene	5.0	100
5	1,4-Dichlorobenzene	5.0	6.43
6	Ethylbenzene	5.0	550
7	Toluene	5.0	52.8
8	Total Xylenes	5.0	245

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-10

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-11

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	78.3
2	Chlorobenzene	5.0	32.0
3	1,2-Dichlorobenzene	5.0	406
4	1,3-Dichlorobenzene	5.0	212
5	1,4-Dichlorobenzene	5.0	8.38
6	Ethylbenzene	5.0	134
7	Toluene	5.0	43.1
8	Total Xylenes	5.0	128

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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(704) 523-4726
FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-464) NAVUST-12

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	161
2	Chlorobenzene	5.0	77.1
3	1,2-Dichlorobenzene	5.0	89.1
4	1,3-Dichlorobenzene	5.0	19.0
5	1,4-Dichlorobenzene	5.0	12.9
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	754
8	Total Xylenes	5.0	7220

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-13

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	85.6
2	Chlorobenzene	5.0	6.77
3	1,2-Dichlorobenzene	5.0	117
4	1,3-Dichlorobenzene	5.0	36.2
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	150
7	Toluene	5.0	20.0
8	Total Xylenes	5.0	300

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-14

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	8.90
8	Total Xylenes	5.0	9.61

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-15A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1880
2	Chlorobenzene	5.0	193
3	1,2-Dichlorobenzene	5.0	134
4	1,3-Dichlorobenzene	5.0	35.9
5	1,4-Dichlorobenzene	5.0	25.7
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	3200
8	Total Xylenes	5.0	18,200

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3, 7, 91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-16A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	5750
2	Chlorobenzene	5.0	36.4
3	1,2-Dichlorobenzene	5.0	114
4	1,3-Dichlorobenzene	5.0	19.0
5	1,4-Dichlorobenzene	5.0	15.6
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	11,500
8	Total Xylenes	5.0	1350

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-17

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	2690
2	Chlorobenzene	5.0	24.6
3	1,2-Dichlorobenzene	5.0	513
4	1,3-Dichlorobenzene	5.0	273
5	1,4-Dichlorobenzene	5.0	13.5
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	735
8	Total Xylenes	5.0	1480

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-18

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	2580
2	Chlorobenzene	5.0	13.7
3	1,2-Dichlorobenzene	5.0	396
4	1,3-Dichlorobenzene	5.0	150
5	1,4-Dichlorobenzene	5.0	18.5
6	Ethylbenzene	5.0	2310
7	Toluene	5.0	65.7
8	Total Xylenes	5.0	1360

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-19

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-20

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

1.0 INTRODUCTION

The subject property has operated as a retail petroleum outlet for the past two to three decades. S&ME conducted environmental monitoring at the subject facility in early 1991 in conjunction with an Underground Storage Tank (UST) system removal. Laboratory analyses conducted on samples collected from the excavation indicated that a release had occurred.

S&ME subsequently installed six monitoring wells to define the vertical and horizonal extent of the contaminant plume at the site. The Assessment Report (AR) was submitted to the South Carolina Department of Health Environmental Control (SCDHEC) in February 1993. The SCDHEC response to the AR was received in April of 1993 wherein the installation of two additional monitoring wells was requested. In addition, the SCDHEC response requested the implementation of Free Product Recovery (FPR). A site location map and a site/monitoring well location plan are included in Appendix I as Figures 1 and 2, respectively.

S&ME submitted an FPR Plan to the SCDHEC in August 1993, with approval subsequently received in September, 1993. S&ME personnel installed the two wells on November 29 and 30, 1994, based upon SCDHEC correspondence dated September 7, 1993 authorizing the installations. The FPR trench system was installed in early January, 1995. This FPR system installation will be the subject of a separate report to be submitted to the SCDHEC once the system is fully operational and re-charge has forced product into the recovery wells. The following report details the field procedures utilized during the referenced well installations, sampling and analysis data and our conclusions regarding the site.

2.0 GROUNDWATER MONITORING WELL INSTALLATION

Two groundwater monitoring wells (CNB-1346-MW-7 and CNB-1346-MW-8) were installed at the subject facility between November 29 and November 30, 1994. The monitoring well locations are detailed in Appendix I, Figure 2. The well locations were determined based on the data obtained during the initial well installations, the location of groundwater utilities and above ground structures. It appears that these wells, in conjunction with previously installed wells, are sufficient to define the vertical and horizontal extent of the contaminant plume.

The groundwater monitoring wells were constructed by advancing 6 1/4-inch outside diameter (O.D.) hollow stem augers to a depth of approximately 13 feet below grade. The boreholes were converted to monitoring wells with the installation of 13 feet of two-inch diameter, schedule 40 PVC casings and screens. A 10-foot section of screen was used in each well with a number 10 (0.010 inch) factory slot size. The screens were installed from approximately two feet above and eight feet below the groundwater table. A clean, coarse, washed filter sand (FX-50) was installed by tremie within the annulus of the wells opposite the well screen and to a depth of one-foot above the tops of the screens. One-foot bentonite pellet seals were placed above the filter sand and the remaining annulus of the wells were filled with neat cement grout. Protective locking well caps were used to seal the tops of the casing to provide security. Steel, watertight, bolt-down manways were set level with the existing grade so as not to interfere with vehicular traffic.

After the installation of the groundwater monitoring wells, the tops of the well casings and locations were surveyed and added to a scaled site plan previously prepared by a surveyor. SCDHEC Water Well Record Forms are included in Appendix II.

Auger cuttings generated from the well installations were containerized in 55-gallon drums. S&ME requested permission to dispose of these drums in correspondence dated February 15, 1995. Upon receipt of approval from the SCDHEC, S&ME personnel will dispose of the drums according to terms set forth in the referenced S&ME correspondence.

3.0 GROUNDWATER MONITORING WELL SAMPLING/ DEVELOPMENT AND LABORATORY ANALYSIS

A minimum waiting period of 24 hours was allowed for the grout seals and concrete pads to become competent prior to well development and sampling. The wells were then developed and sampled in the order of installation. A minimum of 10 well volumes was purged from each well by slow pumping to ensure proper seating of the gravel pack filter prior to sampling. All equipment which was in direct contact with the purged water was decontaminated with a chemically neutral surfactant and rinsed a minimum of three times with deionized water prior to and between each well purged. The purged water from the wells installed on-site was containerized and currently remains on-site.

All eight wells present at the subject site were sampled utilizing disposable bailers brought to the site in factory sealed containers. As the samples were collected from the wells, they were immediately placed into specially prepared sample containers, labeled and placed on ice. The samples were then shipped by overnight courier to Hydrologic Laboratories, Inc. (Hydrologic) in Frankfort, Kentucky for analysis (SCDHEC certification #70002).

Sampling of all wells was conducted on January 9, 1995. This sampling event included collecting a groundwater sample from each of the eight monitoring wells on-site. The samples collected from the wells during this round were analyzed for Benzene, Ethylbenzene, Toluene and Xylenes (BETX) and Methyl-Tert-Butyl Ether (MTBE). In addition, the two recently installed wells (CNB-1346-MW-7 and CNB-1346-MW-8) were sampled for Total Petroleum Hydrocarbons (TPH) by EPA Method 5030. The worst case well parameters had been targeted during the Hydrogeologic Assessment conducted in 1992 and as such were not targeted for analysis during this phase of the assessment. Copies of the Sample Collection Summary Sheets are included in Appendix III. A summary of the water table elevations is presented in Appendix IV as Table 1.

4.0 LABORATORY ANALYSIS RESULTS

The following sections detail the analytical results obtained from samples collected in January, 1995. Analytical results are tabulated in Appendix IV in Tables 2 and 3. Samples collected from the subject site were submitted to Hydrologic for analysis of targeted parameters. Copies of the sample chain of custody forms and laboratory data sheets are included in Appendix V.

4.1 Soil Sample Analysis Results

Soil samples were collected during the installation of CNB-1346-MW-7 and CNB-1346-MW-8 from the capillary fringe. These samples were submitted to Hydrologic for analysis of BTEX constituents by EPA Method 8020 and Total Petroleum Hydrocarbons (TPH) by EPA Method 5030. There were no targeted analytes detected in the soil sample analyses. Soil sample analysis results are tabulated in Appendix IV, Table 2.

4.2 Groundwater Sample Analysis Results

Perimeter wells CNB-1346-MW-1, CNB-1346-MW-2, CNB-1346-MW-3 and CNB-1346-MW-4 were determined to be either free of petroleum constituents (laboratory results reported below quantitation limits (BQL)) or petroleum constituents were detected below drinking water standards (CNB-1346-MW-4).

The telescoping (deep) well sampled during this round did not exhibit indications of petroleum hydrocarbon impact indicating confinement of the impacted region to the upper reaches of the surficial aquifer. Conversely, CNB-1346-MW-5 was re-confirmed as the "worst case well". A 5.0 ppb Benzene Isoconcentration Map is presented in Appendix I as Figure 3 and a summary of the groundwater analytical data is presented in Appendix IV as Table 2.

5.0 POTENTIOMETRIC SURFACE

The potentiometric surface of the surficial aquifer was interpolated utilizing data obtained by collecting water level measurements in all shallow monitoring wells installed on the site and applying this information to a scaled site plan with surveyed well casing elevations. This allowed the plotting of groundwater contours across the site. Appendix I, Figure 4 presents a potentiometric surface map of the site based on the January 5, 1995 gauging data. The sample collection summary sheets for the monitoring wells are provided in Appendix III. As shown in Figure 4, the general direction of groundwater flow is to the east and slightly south. This direction of groundwater flow is consistent with measurements that have been collected in the past.

Guaging data obtained from the recently installed wells (CNB-1346-MW-7 and CNB-1346-MW-8) was not factored into the interpolated contours. Elevation data obtained from those wells appears to indicate that water table elevations at those locations has not yet stabilized. S&ME will monitor water table elevations at the site and submit potentiometric maps in slated Free Product Recovery reports incorporating this data.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the installation, sampling and analysis of two additional monitoring wells at the site, it appears that the horizontal and vertical extent of the dissolved petroleum plume have been defined. Further, S&ME in conjunction with Navy Base personnel, have implemented the Free Product Recovery (FPR) plan approved in SCDHEC correspondence dated September 7, 1993. Due to the clayey nature of soils at the subject facility and the associated low permeability, it is anticipated that "steady state" conditions will take some time to achieve. S&ME personnel will monitor progress of the FPR system and report to the SCDHEC on a quarterly basis. Given the length of time the plume has remained in the subsurface, it would appear that the low permeability of on-site soils will inhibit migration of the contaminants.

With the completion of assessment activities and the implementation of the FPR system, it is recommended that a Corrective Action Plan (CAP) be prepared for the site to address the dissolved petroleum constituent in the groundwater.

7.0 REFERENCES

Bouwer, H. and R.C. Rice. "A slug test for determining hydraulic conductivity of unconfirmed aquifers with completely or partially penetrating wells". Water Resources Research, V.12 (1976), 423-428.

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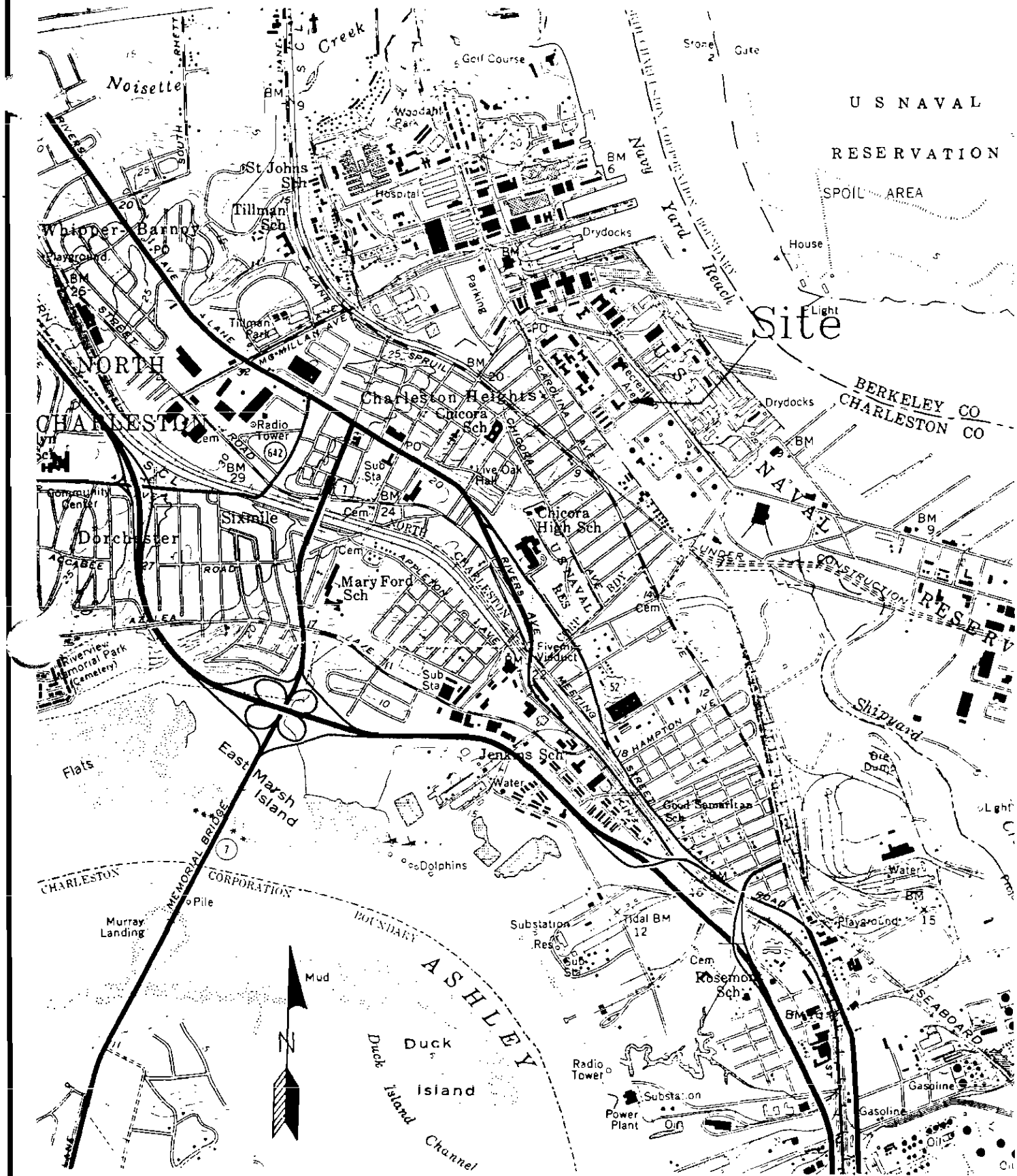
Timm, C.M., Installation Restoration Program, Phase II - Stage 1 Confirmation / Qualification, Charleston Air Force Base, Charleston, South Carolina. Science Applications International Corporation, McLean, VA, 1988.

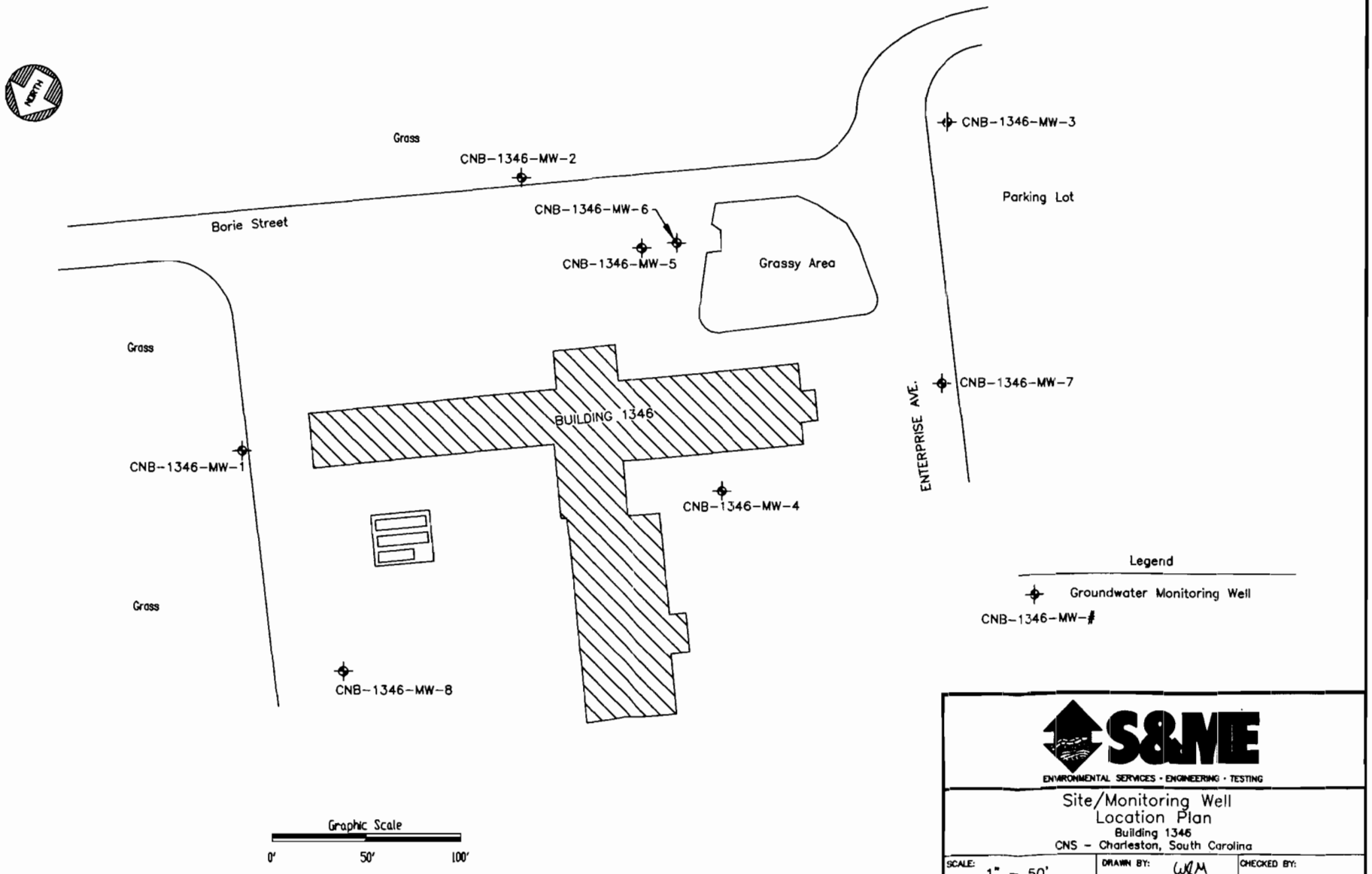
Colquhoun, D.J., et al. Surface and Subsurface Stratigraphy, Structure Aquifers of the South Carolina Coastal Plain. Columbia: University of South Carolina, Department of Geology, 1983.

APPENDIX I

FIGURES



1" = 2000'	S&ME ENVIRONMENTAL SERVICES · ENGINEERING · TESTING	Site Location Map Building 1346 Charleston Naval Station Charleston, South Carolina	FIGURE NO 1
CHECKED BY:			
DRAWN BY:			
DATE: 3-20-95		JOB NO: 1134-93-298	



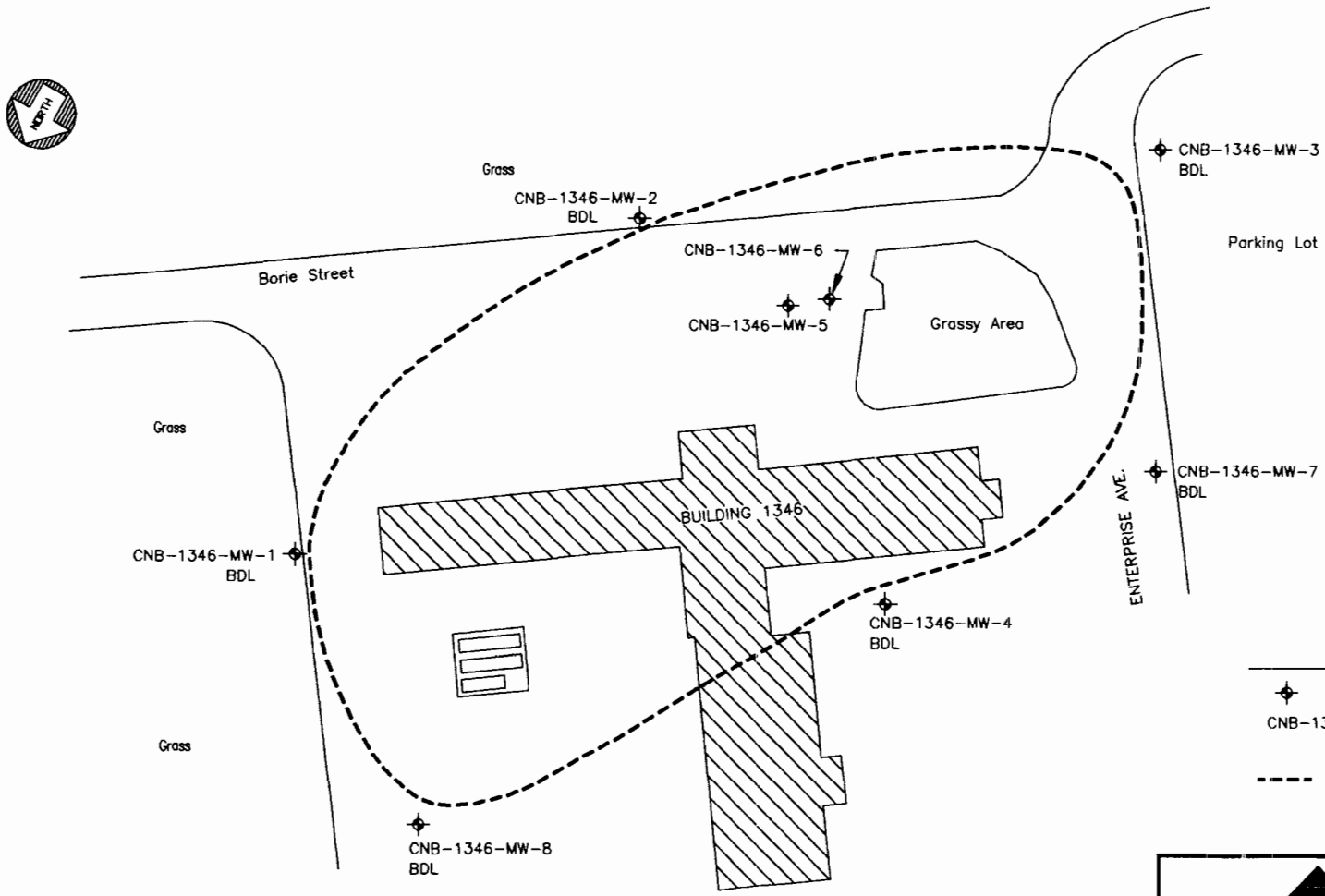
S&ME

ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

Site/Monitoring Well Location Plan

Building 1346
CNS - Charleston, South Carolina

SCALE:	DRAWN BY:	CHECKED BY:
1" = 50'	WJM	
JOB NO. 1134-93-298	DATE: 3-20-95	FIGURE NO. 2



Legend

- Groundwater Monitoring Well CNB-1346-MW-#
- Interpolated <5.0 ppb Benzene Isoconcentration Line

S&ME

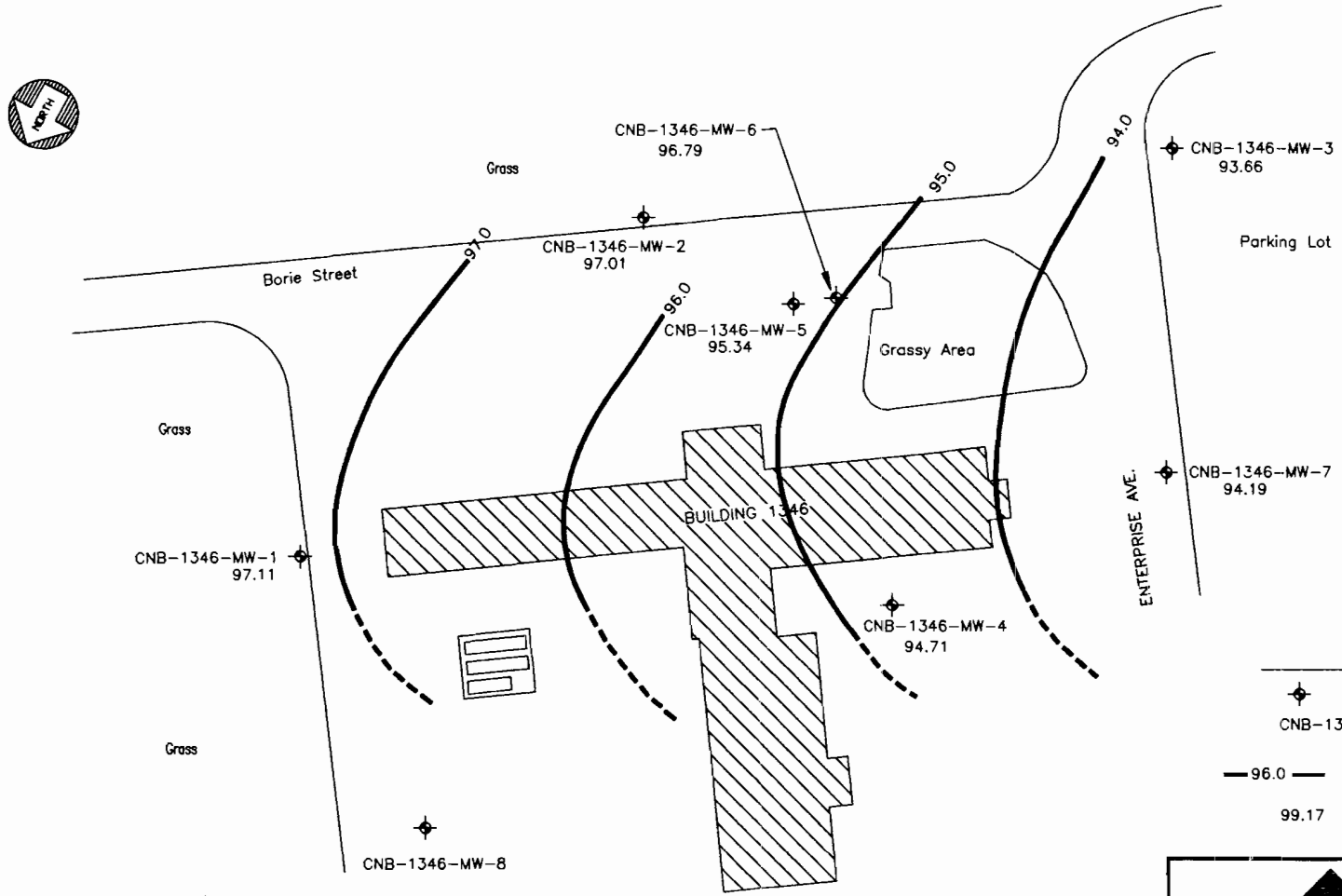
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

Benzene Isoconcentration Plan

Building 1346
CNS – Charleston, South Carolina

SCALE:	DRAWN BY:	CHECKED BY:
1" = 50'	WJM	
JOB NO. 1134-93-298	DATE: 3-30-95	FIGURE NO. 3

4329802.dwg



Legend

- Groundwater Monitoring Well CNB-1346-MW-#
- 96.0 Potentiometric Surface Contor
- 99.17 Water Table Elevation

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Potentiometric Surface Map 1/9/95

Building 1346
CNS – Charleston, South Carolina

SCALE:	DRAWN BY:	CHECKED BY:
1" = 50'	WJM	
JOB NO.	DATE:	FIGURE NO.
1134-93-298	3-30-95	4

APPENDIX II

SCDHEC WATER WELL RECORD FORMS

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | **2600 Bull Street** | **Columbia, S.C. 29201** | **(803) 734-5331** | **Water Well Record**

1. LOCATION OF WELL

County: Charleston System Name: CNB-1346-8

Latitude: [illegible] Longitude: 79°57'5[illegible]

Distance And Direction from Road Intersections

Site occupies southwest corner Enterprise and Boric streets/Charleston Naval Shipyard

Street address & City of Well Location

Sketch Map: (See example on back)

See monitoring well location plan – Figure 4 of Addendum to Assessment Report

2. CUTTING SAMPLES [✓ Yes] No

Geophysical Logs Yes (Please enclose) [✓ No]

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
[illegible]phalt (Pavement)	2"	2"
SP - Silty Sand/Dark Grey	1'10"	2'
CH - Tight Clay/Dark Grey	4'	6'
- Light Grey	2'	8'
- Tan	5'	13'
[illegible]icate water bearing zones (use a 2nd sheet if needed)		

3. REMARKS

4. OWNER OF WELL: Charleston Naval Shipyard

Address: Environmental Protection Div[illegible]
Code 106.2

Telephone No. (803) 743-5519

Engineer: S&ME, Inc.

Address: 840 Lowcountry Blvd.
Mt. Pleasant SC 29464

Telephone No. (803) 884-0005

5. WELL DEPTH (Completed) 13 ft. Date Started 11/29/94 Date Completed 11/30/94

6. Mud Rotary Jetted [✓ Bored] Dug Air Rotary Driven Cable tool Other

7. USE: Domestic Public Supply Permit No. ____ Industry Irrigation Air Conditioning Commercial Test Well [✓ Groundwater Monitoring Well]

8. CASING [✓ Threaded] Welded

Diam 2"

Type [✓ PVC] Galvanized Steel Other

2 in. to 2 ft. depth

____ in. to ____ ft. depth

Height Above/Below Surface ____ ft

Weight ____ lbs./ft.

Drive Shoe? Yes [✓ No]

9. SCREEN:

Type: PVC Diam 2"

Slot/Gauze 0.01" Length 10'

Set Between 2 ft. and 12 ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**

____ ft. and ____ ft.

Sieve Analysis Yes (Please enclose) [✓ No]

10. STATIC WATER LEVEL

____ ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. pumping ____ G.P.M.

Pumping Test Yes (Please enclose) [✓ No]

Yield ____

12. WATER QUALITY

Chemical Analysis [✓ Yes] No Bacterial Analysis Yes [✓ No]

Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) [✓ Yes] No

Installed from 2 ft. to 13 ft.

Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? [✓ Yes] No

[✓ Neat Cement] Sand Cement Concrete Other ____

Depth From 0 ft. to 1 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION ____ Feet ____ Direction

Petroleum Hydrocarbon Type

Well disinfected upon completion Yes [✓ No] Type ____ Amount ____

16. PUMP Date Installed ____ [✓ not installed]

Mfr. name ____, model no ____

H.P. ____ volts ____ length of drop pipe ____ ft capacity ____ gpm

TYPE: Submersible Jet (shallow) Turbine Jet (deep) Reciprocating Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: S&ME, Inc. ADDRESS: 840 Lowcountry Blvd. Mt. Pleasant SC 29464

Signed: C. E. Stutts CERT. NO. 716

AUTHORIZED REPRESENTATIVE Date 11/30/94

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division **2600 Bull Street** **Columbia, S.C. 29201** **(803) 734-5331** **Water Well Record**

1. LOCATION OF WELL

County: Charleston System Name: CNB-1346-7

Latitude: [illegible] Longitude: 79° 57' [illegible]

Distance And Direction from Road Intersections

Site occupies southwest corner Enterprise and Borie streets/Charleston Naval Shipyard

Street address & City of Well Location

Sketch Map: (See example on back)

See monitoring well location plan - Figure 4 of Addendum to Assessment Report

2. CUTTING SAMPLES [✓ Yes] No

Geophysical Logs Yes (Please enclose) [✓ No]

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
sphalt (Pavement)	2"	2"
SP - Sandy black topsoil	2'	2'
CH - Red Clay	4'	6'
- Grey Clay	7'	13'
cate water bearing zones (use a 2nd sheet if needed)		

3. REMARKS

4. OWNER OF WELL
Address: Charleston Naval Shipyard, Environmental Protection [illegible] Code 106.2
Telephone No. (803) 743-5519

Engineer: S&ME, Inc.
Address: 840 Lowcountry Blvd. Mt. Pleasant SC 29464
Telephone No. (803) 884-0005

5. WELL DEPTH (Completed) 13 ft. Date Started 11/29/94 Date Completed 11/30/94

6. Mud Rotary Jetted [✓ Bored] Dug
Air Rotary Driven Cable tool Other

7. USE:
Domestic Public Supply Permit No. ______ Industry
Irrigation Air Conditioning Commercial
Test Well [✓ Groundwater Monitoring Well]

8. CASING [✓ Threaded] Welded
Diam. 2"
Type [✓ PVC] Galvanized
Steel Other
2 in. to 2 ft. depth
______ in. to ______ ft. depth

Height. Above/Below
Surface ______ ft.
Weight ______ lbs./ft.
Drive Shoe? Yes [✓ No]

9. SCREEN:
Type: PVC Diam. 2"
Slot/Gauze 0.01" Length 10'
Set Between 2 ft. and 12 ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**
______ ft. and ______ ft.
Sieve Analysis Yes (Please enclose) [✓ No]

10. STATIC WATER LEVEL
______ ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
______ ft. after ______ hrs. pumping ______ G.P.M.
Pumping Test Yes (Please enclose) [✓ No]
Yield ______

12. WATER QUALITY
Chemical Analysis [✓ Yes] No Bacterial Analysis Yes [✓ No]
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) [✓ Yes] No
Installed from 2 ft. to 13 ft.
Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? [✓ Yes] No
[✓ Neat Cement] Sand Cement Concrete Other ______
Depth From 0 ft. to 1 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION ______ Feet ______ Direction
Petroleum Hydrocarbon Type
Well disinfected upon completion Yes [✓ No] Type ______ Amount ______

16. PUMP Date Installed ______ [✓ not installed]
Mfr. name ______ model no. ______
H.P. ______ volts ______ length of drop pipe ______ ft. capacity ______ gpm
TYPE Submersible Jet (shallow) Turbine
Jet (deep) Reciprocating Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME S&ME, Inc. ADDRESS 840 Lowcountry Blvd. Mt. Pleasant SC 29464

Signed C. E. Stutts CERT. NO. 716
AUTHORIZED REPRESENTATIVE Date 11/30/94

DHEC # 1903 (10/86) **COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)**

APPENDIX III

SAMPLE COLLECTION SUMMARY SHEETS

SAMPLE COLLECTION SUMMARY SHEET

General

Job Name: NAVY BLDG. 1346
2. Project No.: 1134-93-298
3. Sampled By: TODD T. / FRANK S.
4. Weather: COOL / SUNNY
5. Location: NAVY BASE
6. Well #: 1346- 1
7. Well Condition: Good
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 2:20 3. Static Water Level: 2 29 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 3"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 2:20 3. Time Evacuation Finished: 2:35
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 11.6 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 8.71 Ft
8. Volume of Water in Well (0.041D²H) = 1.42 X 3 = 4.28 Gallons
Well Volume X # Volumes = Total Gallons Purged

Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	ø	.86	1.71	2.57	2.99	4.25
Water Temperature (F) (C)	20°C	18C	18°C	18°C	18°C	18°C
PH (Standard Units)	860	1110	2890	2950	3870	3950
Specific Cond. (M/MHOS) (PPM)	7.06	6.99	6.83	6.82	6.85	6.93
Turbidity (Subjective)	Clear	Clear	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	ø	ø	ø	ø	ø	ø
Other:						

Sampling Information

1. Date: 1/9/95 2. Time: 2:15 3. Sample Containers (Number/Size/Type): 2- 40ml vials
Analyses requested: 602 + MTBE
Samples Filtered: no 6. Filtration Equipment: n/a
7. Samples Preserved: yes 8. Preservative: HCL
9. Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

1. Job Name: NAVY BLDG. 1346
   Sampled By: TODD T. / FRANK S.
5. Location: NAVY BASE
7. Well Condition: Good

2. Project No.: 1134-93-298
4. Weather: COOL / SUNNY
6. Well #: 1346- 2
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 1:50 3. Static Water Level: 2.20 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 3"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 1:50 3. Time Evacuation Finished: 2:10
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 12.0 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 9.8 Ft
8. Volume of Water in Well ($0.041D^2H$) = 1.61 X 3 = 4.82 Gallons
   Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	Ø	.96	1.92	2.88	3.84	4.82
Water Temperature (F) (C)	22°C	18°C	18°C	18°C	18°C	18°C
PH (Standard Units)	6.65	6.80	6.75	6.45	6.53	6.64
Specific Cond. (M/MHOS) (PPM)	620	870	490	400	510	510
Turbidity (Subjective)	Clear	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	Ø	Ø	Ø	Ø	Ø	Ø
Other: _____						

Sampling Information

1. Date: 1/9/95 2. Time: 2:16 3. Sample Containers (Number/Size/Type): 2- 40ml vials
4. Analyses requested: 602 + MTBE
5. Samples Filtered: no 6. Filtration Equipment: n/a
   Samples Preserved: yes 8. Preservative: HCL
   Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

1. Job Name: NAVY BLDG. 1346
   Sampled By: TODD T. / FRANK S.
5. Location: NAVY BASE
7. Well Condition: Bad
2. Project No.: 1134-93-298
4. Weather: COOL / SUNNY
6. Well #: 1346- 3
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 1:00 3. Static Water Level: 5.00 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/(below) (Circle) Land Surface: 4"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 1:00 3. Time Evacuation Finished: 1:25
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 12.0 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 7.0 Ft
8. Volume of Water in Well ($0.041D^2H$) = 1.14 X 3 = 3.44 Gallons
   Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	0	.68	1.38	2.06	2.73	3.44
Water Temperature (F) (C)	18°C	20°C	20°C	21°C	22°C	22°C
PH (Standard Units)	5.52	5.67	5.52	5.56	5.38	5.38
Specific Cond. (M/MHOS) (PPM)	930	930	940	1070	1010	1020
Turbidity (Subjective)	Clear	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	0	0	0	0	0	0
Other:						

Sampling Information

1. Date: 1/9/95 2. Time: 1:25 3. Sample Containers (Number/Size/Type): 2- 40ml vials
4. Analyses requested: 602 + MTBE
5. Samples Filtered: no 6. Filtfation Equipment: n/a
   Samples Preserved: yes 8. Preservative: HCL
   Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

1. Job Name: NAVY BLDG. 1346
2. Project No.: 1134-93-298
Sampled By: TODD T. / FRANK S.
4. Weather: COOL / SUNNY
5. Location: NAVY BASE
6. Well #: 1346- 4
7. Well Condition: Good
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 12:20 3. Static Water Level: 4.79 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 3"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 12:20 3. Time Evacuation Finished: 12:30
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 12.0 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 7.21 Ft
8. Volume of Water in Well ($0.041D^2H$) = 1.18 X 3 = 3.5 Gallons
Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	0	.7	1.4	2.1	2.8	3.5
Water Temperature (F) (C)	20c	22°c	22°c	20°c	20°c	20°c
PH (Standard Units)	6.25	6.50	6.50	6.57	6.61	6.62
Specific Cond. (M/MHOS) (PPM)	670	670	650	660	680	680
Turbidity (Subjective)	Clear	Clear	Clear	clear	Clear	Clear
Odor (Subjective)	ø	ø	ø	ø	ø	ø
Other:						

Sampling Information

1. Date: 1/9/95 2. Time: 12:30 3. Sample Containers (Number/Size/Type): 2- 40ml vials
4. Analyses requested: 602 + MTBE
5. Samples Filtered: no 6. Filtration Equipment: n/a
7. Samples Preserved: yes 8. Preservative: HCL
9. Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

Job Name: NAVY BLDG. 1346
2. Project No.: 1134-93-298
Sampled By: TODD T. / FRANK S.
4. Weather: COOL / SUNNY
5. Location: NAVY BASE
6. Well #: 1346- 5
7. Well Condition: Good
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 2:50 3. Static Water Level: 4.23 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 2'
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 2:50 3. Time Evacuation Finished: 3:30
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 12.0 Ft Below M.P.
6. Casing Diameter (D): 4 inches 7. HT. of water column (H - Well Depth - Water Level): 7.77 Ft
8. Volume of Water in Well ($0.041D^2H$) = 5.09 X 3 = 15.29 Gallons
Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	0	3.05	6.11	9.16	12.21	15.29
Water Temperature (F) (C)	18°C	18°C	18°C	18°C	18°C	18°C
PH (Standard Units)	5.57	6.07	6.25	5.55	5.69	6.44
Specific Cond. (M/MHOS) (PPM)	730	240	360	250	340	270
Turbidity (Subjective)	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	Strong	Strong	Strong	Strong	Strong	Strong
Other: _____						

Sampling Information

1. Date: 1/9/95 2. Time: 3:30 3. Sample Containers (Number/Size/Type): 2- 40ml vials
4. Analyses requested: 602 + MTBE
5. Samples Filtered: no 6. Filtration Equipment: n/a
Samples Preserved: yes 8. Preservative: HCL
Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

Job Name: NAVY BLDG. 1346
2. Project No.: 1134-93-298
Sampled By: TODD T. / FRANK S.
4. Weather: COOL / SUNNY
5. Location: NAVY BASE
6. Well #: 1346- 6
7. Well Condition: Good
8. Personnel Present: TODD / FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 3:40 3. Static Water Level: 4.69 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 3"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 3:40 3. Time Evacuation Finished: 4:20
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 26.0 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 21.31 Ft
8. Volume of Water in Well ($0.041 D^2H$) = 3.49 X 3 = 10.48 Gallons
Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	0	2.0	4.2	6.6	8.8	10.48
Water Temperature (F) (C)	18°	18°C	18°C	18°C	20°C	20°C
PH (Standard Units)	8.34	7.57	7.19	7.35	7.10	7.08
Specific Cond. (M/MHOS) (PPM)	4190	4230	4766	5210	5230	4670
Turbidity (Subjective)	Clear	Clear	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	0 mild	0 mild	0 mild	mild	mild	mild
Other: _____						

Sampling Information

1. Date: 1/9/95 2. Time: 4:20 3. Sample Containers (Number/Size/Type): 2- 40ml vials
4. Analyses requested: 602 + MTBE
5. Samples Filtered: no 6. Filtration Equipment: n/a
Samples Preserved: yes 8. Preservative: HCL
9. Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

Job Name: NAVY BLDG. 1346
2. Project No.: 1134-93-298
Sampled By: TODD T. / FRANK S.
4. Weather: COOL / SUNNY
5. Location: NAVY BASE
6. Well #: 1346- 7
7. Well Condition: New
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 11:00 3. Static Water Level: 4.75 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 4"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 11:00 3. Time Evacuation Finished: 11.35
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 12 0 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 7.25 Ft
8. Volume of Water in Well (0.041 D^2H) = 1.18 x 10 = 11.89 Gallons
Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

Vol. Purged (Cummul. Gals)	ø	2.38	4.76	7.14	9.52	11.89
Water Temperature (F) (C)	22 C	21°C	22°C	22°C	20°C	18°C
PH (Standard Units)	5.43	5.45	5.47	5.39	5.37	5.49
Specific Cond. (M/MHOS) (PPM)	440	340	290	270	530	470
Turbidity (Subjective)	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	ø	ø	ø	ø	ø	ø
Other: _____						

Sampling Information

1. Date: 1/9/95 2. Time: 11:35 3. Sample Containers (Number/Size/Type): 3 - 40ml vials
4. Analyses requested: 602 + MTBE TPH 5030
5. Samples Filtered: no 6. Filtration Equipment: n/a
Samples Preserved: yes 8. Preservative: HCL
9. Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

SAMPLE COLLECTION SUMMARY SHEET

General

Job Name: NAVY BLDG. 1346
2. Project No.: 1134-93-298
Sampled By: TODD T. / FRANK S.
4. Weather: COOL / SUNNY
5. Location: NAVY BASE
6. Well #: 1346- 8
7. Well Condition: New
8. Personnel Present TODD/FRANK

Water Level Information

1. Date: 1/9/95 2. Time: 10.00 3. Static Water Level: 3 34 Ft Below M.P.
4. Description of Measuring Point (M.P.): HIGH SIDE OF PVC CASING
5. Height of M.P. above/below (Circle) Land Surface: 4"
6. Method of Water Level Measurement: ELECTRONIC WATER OR OIL/WATER INTERFACE PROBE

Evacuation Procedure (Wells)

1. Date: 1/9/95 2. Time Evacuation Started: 10:00 3. Time Evacuation Finished: 10:40
4. Method of Evacuation: DISPOSABLE BAILER 5. Total Well Depth: 13.0 Ft Below M.P.
6. Casing Diameter (D): 2 inches 7. HT. of water column (H - Well Depth - Water Level): 9.66 Ft
8. Volume of Water in Well ($0.041D^2H$) = 1.58 X 10 = 15 84 Gallons
Well Volume X # Volumes = Total Gallons Purged
9. Decontamination Procedure: STANDARD S&ME PROCEEDURES

Meter Calibration:

Buffer PH 7.0 _____ (Actual) Buffer PH 4.0 or 10.0 _____ (Actual) _____ (Standard) Cond: _____ (Actual)

Record of Well Evacuation

		3.16	6.33	9.50	12.66	15.84
Vol. Purged (Cummul. Gals)	~~0~~	~~3.16~~	~~6.33~~	~~9.50~~	~~12.66~~	~~15.84~~
Water Temperature (F) (C)	24c	23c	22c	22c	22c	23c
PH (Standard Units)	5.75	5.84	5.71	5.65	5.73	5.67
Specific Cond. (M/MHOS) (PPM)	2290	2070	2230	2410	2500	2710
Turbidity (Subjective)	~~0~~	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Odor (Subjective)	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
Other:						

Sampling Information

1. Date: 1/9/95 2. Time: 10:40 3. Sample Containers (Number/Size/Type): 3 x 40ml vials
4. Analyses requested: 602 + MTBE TPH 5030
5. Samples Filtered: no 6. Filtration Equipment: n/a
Samples Preserved: yes 8. Preservative: HCL
9. Lab Performing Analyses: HYDROLOGIC 10. Sample Type: Well PVC ; Stream _____

APPENDIX V

SAMPLE CHAIN OF CUSTODY/LABORATORY DATA SHEETS

H Y D R O L O G I C , I N C .

December 9, 1994

REPORTING:

S & ME, Inc.
840 Low Country Blvd.
Mt. Pleasant, SC 29464

Attention: Keene Fleck

INVOICING:

S & ME, Inc.
840 Low Country Blvd.
Mt. Pleasant, SC 29464

PROJECT NUMBER: FL9434677

DATE COMPLETED: December 9, 1994
DATE RECEIVED: December 6, 1994

PROJECT DESCRIPTION:

#1134-93-298--2 soil samples analyzed for 8020 + MTBE/5030.

Enclosed is the laboratory report for the project described above. If you have any questions or if we can be of further assistance, please feel free to contact Jamie Fore. We appreciate your business and look forward to serving you again soon.

Respectfully,

Benjamin Carl Esterle/mjs
Benjamin Carl Esterle
Laboratory Director

1491 Twilight Trail ☐ Frankfort, KY 40601 ☐ 502/223-0251 ☐ FAX 502/875-8016 ☐ Toll Free 1-800/728-2251

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298

HYDROLOGIC PROJECT NUMBER: FL9434677
HYDROLOGIC SAMPLE NUMBER: 34677
HYDROLOGIC LAB I.D.#: 70002
SAMPLE IDENTIFICATION: MW-7
DATE SAMPLED: 11/29/94
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 12/7/94

METHOD EPA 8020

ANALYSIS	CAS NO.	SDL (ug/kg)	RESULT (ug/kg)
Benzene	71-43-2	6.0	BDL
Toluene	108-88-3	6.0	BDL
Ethylbenzene	100-41-4	6.0	BDL
Xylene (Total)	1330-20-7	6.0	BDL
MTBE		30.0	BDL

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298

HYDROLOGIC PROJECT NUMBER: FL9434677
HYDROLOGIC SAMPLE NUMBER: 34677
HYDROLOGIC LAB I.D.#: 70002
SAMPLE IDENTIFICATION: MW-7
DATE SAMPLED: 11/29/94
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 12/4/94

METHOD TPH 5030

ANALYSIS	CAS NO.	SDL (mg/kg)	RESULT (mg/kg)
Gasoline		2.0	BDL

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298

HYDROLOGIC PROJECT NUMBER: FL9434677
HYDROLOGIC SAMPLE NUMBER: 34678
HYDROLOGIC LAB I.D.#: 70002
SAMPLE IDENTIFICATION: MW-8
DATE SAMPLED: 11/29/94
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 12/8/94

METHOD EPA 8020

ANALYSIS	CAS NO.	SDL (ug/kg)	RESULT (ug/kg)
Benzene	71-43-2	6.0	BDL
Toluene	108-88-3	6.0	BDL
Ethylbenzene	100-41-4	6.0	BDL
Xylene (Total)	1330-20-7	6.0	BDL
MTBE		30.0	BDL

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298

HYDROLOGIC PROJECT NUMBER: FL9434677
HYDROLOGIC SAMPLE NUMBER: 34678
HYDROLOGIC LAB I.D.#: 70002
SAMPLE IDENTIFICATION: MW-8
DATE SAMPLED: 11/29/94
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 12/7/94

METHOD TPH 5030

ANALYSIS	CAS NO.	SDL (mg/kg)	RESULT (mg/kg)
Gasoline		2.0	BDL

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

REPORT TO:
S&ME, Inc. / Keene Fleck
840 Lowcountry Blvd.
Mt Pleasant SC 29464
94-346077

CHAIN OF CUSTODY

PO # 005946

Page 1 of 1

HydroLogic, Inc.

100 Ashland Park Lane
Columbia, SC 29210
803-750-0913 800-243-0913

Method of Shipment: Anderson Armored Car

FOR SAMPLE MATRIX: W=WATER OR LIQUID S=SOIL OR SOLID
FOR SAMPLE TYPE: G = GRAB C = COMPOSITE

* PROGRAM IDENTIFICATION UST UNLESS OTHERWISE STATED

CLIENT: S&ME, Inc
PHONE: (803)884-0005
PROJ #: 1134-93-298
SAMPLER:

ENTER PRESERVATION CODE A-NONE B-HCl C-NaOH D-H2SO4 E-HNO3 F-OTHER(SPECIFY)

PROJECT ID #:
REPORT DUE:
VERBAL FAX COPY HARD COPY

FIELD ID	SAMPLE MATRIX	COLLECTION TIME	COLLECTION DATE	SAMPLE TYPE	BTEX M602/8020	TPH VOLATILES 5030	TPH SEMI/VOLATILES 3550	MTBE	NAPHTHALENE	PAH'S	SEMI\VOL. GC/MS (BNA)	VOLATILES GC/MS	OIL AND GREASE	LEAD ONLY	8 RCRA METALS	OTHER SPECIFY IN REMARKS	NUMBER OF CONTAINERS	PROGRAM IDENTIFICATION *	REMARKS	LABORATORY'S SAMPLE ID#
MW-7	W (S)		11/29	G	X	X											2		602 to include MTBE	
MW-8	W (S)		11/29	G	X	X											2		602 to include MTBE	
	W S																			
	W S																			
	W S																			
	W S																			
	W S																			
	W S																			
	W S																			

RELINQUISHED BY: J. Keene Fleck	DATE: 12/5/94	TIME: 4:15	RECEIVED BY: Stu Baker
RELINQUISHED BY: Stu Baker	DATE: 12/5	TIME: 4:15	RECEIVED BY:
LAB RECEIPT BY:	DATE:	TIME:	REMARKS: Detection limits must conform to drinking water

January 19, 1995

REPORTING:

S & ME, Inc.
840 Low Country Blvd.
Mt. Pleasant, SC 29464

Attention: Keene Fleck

INVOICING:

S & ME, Inc.
840 Low Country Blvd.
Mt. Pleasant, SC 29464

PROJECT NUMBER: FL951430

DATE COMPLETED: January 19, 1995
DATE RECEIVED: January 12, 1995

PROJECT DESCRIPTION:

#1134-93-298 Bldg. 1346--8 water samples analyzed for 5030/602 + MTBE.

Enclosed is the laboratory report for the project described above. If you have any questions or if we can be of further assistance, please feel free to contact Jamie Fore. We appreciate your business and look forward to serving you again soon.

Respectfully,

Benjamin Carl Esterle
Laboratory Director

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951435
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-1
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/17/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		5.0	BDL
Surrogate Recovery:			
BFB			73%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951434
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-2
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/17/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		5.0	BDL
Surrogate Recovery:			
BFB			72%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951433
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-3
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/17/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		5.0	BDL
Surrogate Recovery:			
BFB			75%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951432
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-4
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/17/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		5.0	BDL
Surrogate Recovery:			
BFB			75%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951436
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-5
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/19/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	**71-43-2**	**500**	**36100**
Ethylbenzene	**100-41-4**	**500**	**3620**
Toluene	**108-88-3**	**500**	**47800**
Xylene (Total)	**1330-20-7**	**500**	**16800**
MTBE		**2500**	**62200**

Surrogate Recovery:
BFB 98%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: DILUTION FACTOR X 500

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951437
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-6
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/19/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		**5.0**	**189**
Surrogate Recovery:			
BFB			109%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951431
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-7
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/15/95

METHOD TPH 5030

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Gasoline		1000	BDL

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951431
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-7
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/17/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		5.0	BDL
Surrogate Recovery:			
BFB			87%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951430
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-8
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/15/95

METHOD TPH 5030

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Gasoline		1000	BDL

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

COMPANY NAME: S & ME, Inc.
COMPANY PROJECT NUMBER: #1134-93-298 BLDG. 1346

HYDROLOGIC PROJECT NUMBER: FL951430
HYDROLOGIC SAMPLE NUMBER: 951430
HYDROLOGIC LAB I.D. #: 399
SAMPLE IDENTIFICATION: 1346-8
DATE SAMPLED: 1/9/95
DATE EXTRACTED: N/A
DATE/TIME ANALYZED: 1/17/95

METHOD EPA 602/MTBE

ANALYSIS	CAS NO.	SDL (ug/l)	RESULT (ug/l)
Benzene	71-43-2	1.0	BDL
Ethylbenzene	100-41-4	1.0	BDL
Toluene	108-88-3	1.0	BDL
Xylene (Total)	1330-20-7	1.0	BDL
MTBE		5.0	BDL
Surrogate Recovery:			
BFB			84%

BDL = Below Sample Detection Limit
SDL = Sample Detection Limit

COMMENTS: _____

CHAIN OF CUSTODY

HydroLogic Inc.
201 Summit View Drive, Suite 90
Brentwood, TN 37027
615-377-6760
800-640-4832

Page 1 of 1

F195130

Report To:
S+ME
840 Low Country Blvd.
Mt. Pleasant SC
29464

CLIENT INFORMATION

Name: Karen Flecke
Phone: 803-884-0005
Project #: 1134-93-298 Bldg. 1346
P.O. #: 6056

Field ID	Matrix	Date/Time Collected	Pres.	Sampled By	TPH 5030	602 BTEX + MTBE								COMMENTS	Lab ID#	Temp	pH	Volume
1346-8	Water	1/9 10:40	HCL	FS	X	X							*	Detection Limits are				
1346-7	"	" 11:35	"	"	X	X								to Conform to				
1346-4	"	" 12:30	"	"		X								Drinking Water				
1346-3	"	" 1:25	"	"		X								Standards *				
1346-2	"	" 2:10	"	"		X												
1346-1	"	" 2:35	"	"		X												
1346-5	"	" 3:30	"	"		X												
1346-6	"	" 4:20	"	"		X												

ANALYSIS | **COMMENTS** | **LAB USE ONLY**

Proj #:
Shipped By:

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE:	TIME:
F. Slaughter	1/11/95	10:00	Anderson Armored Car	1/11/95	10:00
[illegible] Baker	1/11/95	4:30			

ASSESSMENT REPORT ADDENDUM
BUILDING NO. 1346
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA
GWPD ID #14067

Prepared For:

Navy Public Works Center Jacksonville
Charleston Zone
3511 Rivers Avenue
North Charleston, South Carolina 29405-7744

Prepared By:

S&ME, Inc.
840 Low Country Boulevard
Mount Pleasant, South Carolina 29464

March 29, 1995

April 12, 1995

South Carolina Department of
Health and Environmental Control
Groundwater Protection Division
2600 Bull Street
Columbia, South Carolina 29201

ATTENTION: Mr. Andrew Mettlen

Reference: **ASSESSMENT REPORT ADDENDUM**
Building No. 1346
Charleston Naval Base
Charleston, South Carolina
GWPD ID #14067
S&ME, Inc. Project No. 1134-93-298

Dear Mr. Addison:

S&ME, Inc. (S&ME) appreciates the opportunity to submit this correspondence for your review. In response to South Carolina Department of Health and Environmental Control (SCDHEC) correspondence dated April 16, 1993, S&ME has conducted additional monitoring well installations in accordance with the terms set forth in the SCDHEC well installations approval letter dated September 7, 1993.

We hope that this correspondence is responsive to your needs. If we can be of any further assistance or provide any additional information please feel free to contact us at (803) 884-0005.

Sincerely,
S&ME, Inc.

J. Keene Fleck, P.G.
Project Geologist

Sonny Chestnut, P.E.
Senior Environmental Engineer

JKF/SC/dd
cc: Mr. Carl Ray
Mr. Jerry Addison

TABLE OF CONTENTS

FREE PRODUCT RECOVERY PLAN
BUILDING 1346
GWPD Site ID# A-10-AA-14067
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

Prepared For:

Public Works Department, Building 12
Charleston Naval Shipyard
Charleston Naval Base
Charleston, South Carolina

Prepared By:

S&ME, Inc.
840 Low Country Boulevard
Mt. Pleasant, SC 29464

August 12, 1993

TABLE OF CONTENTS

1.0 BACKGROUND

The subject site is a retail gasoline service station (Exchange Service Station) denoted as Building 1346 on the Charleston Naval Station in Charleston, South Carolina. A location plan for the site is presented as Figure 1. A site plan for the site is presented as Figure 2.

The Exchange Service Station has had twelve Underground Storage Tanks (USTs) on-site. The first USTs installed consisted of four 4,000 gallon steel USTs situated within the same tank basin, one remotely located 10,000 gallon steel UST and one presently active 500 gallon waste oil UST. These tanks were reported in a 1987, Harding Lawson Associates report as being installed at least 20 years ago. All of the tanks were constructed of steel and had steel piping. These tanks except the waste oil UST, were abandoned at varying times ranging from 6 - 15 years ago. With the abandonment of the five tanks, the site was retrofitted with three 10,000 gallon steel tanks. The tanks had steel piping and were used for storage of gasoline. Two of the USTs, were situated within the same tank basin. The third UST was remotely located in an isolated tank basin to the north of the site near the two northern most dispensing islands. The tanks were taken out of operation in February 1991, following a failed tank tightness test and were subsequently removed. The former UST basins at the site are as shown on Figure 2.

The site is presently operating with three new 10,000 gallon double walled fiberglass tanks with double walled fiberglass piping which were installed shortly after the previously described tanks were taken out of service. Two of the tanks have pressurized piping system, while one of the tanks is a suction system. These tanks were installed in 1991 and are identified on Figure 2.

As a result of the failed tank tightness tests, S&ME was contracted to perform a Site Closure Assessment (dated March 21, 1991) to determine if a release had occurred. Analytical results of soil samples collected within the UST basins, along product piping, and at the pump island indicated the presence of petroleum hydrocarbon related contamination at varying levels confirming that a release had occurred.

S&ME then completed a Hydrogeologic Assessment of the site which was received by the SCDHEC on January 14, 1993. This work included conducting a soil vapor survey and the installation of groundwater monitoring wells to determine to extent of contamination at the site. This assessment report identified that free product was present on-site and further presented that because of the nature of the soil on-site, the use of wells may be ineffective as free product only recovery method. It was also stated in the report that a recovery trench may be necessary to prevent further migration of the free product and to provide an effective means to recover this product.

Based on the results of the previously referenced hydrogeologic assessment, S&ME was contracted by the Charleston Naval Base to prepare a free product recovery plan for the site in an effort to satisfy Section 280.64 of the South Carolina Underground Storage Tank Control Regulations (R.61-92). This plan which includes the installation of a recovery trench with free product only pumps and an operation and maintenance program is presented herein. This free product recovery plan is intended to describe the installation of a recovery trench which will limit further migration of free product until such time that a total site remediation system is installed. After that time the trench described herein will be converted to a total fluids recovery system.

2.0 RECOVERY PLAN

S&ME's proposed free product recovery plan includes initially completing auger borings on-site to assess the current extent of the free product plume. Once the limits of the free product plume are determined, an interceptor trench is recommended to be constructed adjacent to and on the down gradient side of the plume. Upon completion of the construction of the trench, a recovery system designed by S&ME would be installed in the trench to serve as a "free product only" recovery system. The free product recovered will be pumped from the recovery trench to a storage tank located on-site for storage and subsequent disposal off-site. The recovery plan also includes an operation and maintenance plan for the trench system and the preparation of quarterly reports of the free product activities. The following sections present a detailed discussion of each phase of work.

2.1 VERIFICATION OF FREE PRODUCT PLUME

S&ME proposes to perform hand auger borings in the area of the free product plume to approximate the current lateral extent of the plume. This will assure that the trench will be installed immediately on the downgradient side of the plume such that the maximum amount of free product will be recovered. It is proposed that the borings be performed on a 25 foot grid pattern and constructed as necessary to define the limits of the plume. Based on current information available concerning the site, it is estimated that a minimum of six and a maximum of 12 auger borings will be required to accurately define the limits of the plume. The auger borings will be constructed to a depth of approximately 3 feet below the groundwater table and allowed to remain open for 2-3 hours. The boreholes would then be monitored to verify the presence and thickness of free product at each location. Once the extent of the plume is determined the individual auger borings will be abandoned by filling the holes with a neat cement grout from the bottom up. The estimated locations of the auger borings are identified on Figure 3.

2.2 CONSTRUCTION OF RECOVERY TRENCH

The information obtained from the free product assessment will be utilized to determine the size and location of the recovery trench to be constructed (Figure 3 shows the estimated location of the trench at this time. However, it is estimated that the recovery trench will be 3-feet wide and 70-feet long and a maximum of 8 feet deep). The recovery trench will consist of a T-shaped high permeability trench that is constructed adjacent to and on the down gradient side of the contaminant plume. The trench will be constructed by first excavating a portion of the trench, lining it with a geotextile fabric, and then backfilling the excavation with pea gravel . The contaminated excavated soils will be stockpiled on and completely covered until the soils can be sampled and characterized for disposal. Based upon the free product in the area of the excavation, it is likely this material will require incineration. To attempt to prevent further migration of the free product downgradient and to prevent infiltration of clean, downgradient water, the downgradient side of the trench will be lined with a 60-mil HDPE liner material. During the construction process, the trench would be sloped from the ends to the center in a sump type arrangement in case it is ever desired to pump total fluids from the trench. In addition, during the backfilling operation, two four-inch recovery wells (slotted schedule 40 PVC) will be placed in the trench at the locations shown in Figure 3. The well heads of these recovery wells will be completed below ground surface in locking protective vaults.

2.3 RECOVERY SYSTEM DESCRIPTION

The recovery wells previously described will be equipped with two "AquaTRAC™" product only pumps manufactured by R.E. Wright Associates, Inc. (Note: This pumping system can also be used during the total fluids recovery phase of the remediation). These air-driven bladder pumps are designed to collect and transfer free product only from the recovery locations in the trench to a storage tank located on-site. The transfer of free product from the pumps to the storage tanks will be conducted via tubing encased in four-inch conduit. This conduit will be laid in a trench that is approximately 24 inches in depth and 65 feet long. The conduit will also carry the air supply lines that operate the pumps.

The recovered product will be pumped into a 1,000 gallon product recovery tank. The recovery tank will have secondary containment and will have a mechanical pneumatic shutoff valve to stop the pumps when the tank is approximately 90 percent full.

The system will be operated pneumatically and is therefore intrinsically safe. The air source will be located away from the wells and the storage tank thereby eliminating the need for explosion proof electrical equipment.

2.4 SYSTEM OPERATION AND MAINTENANCE

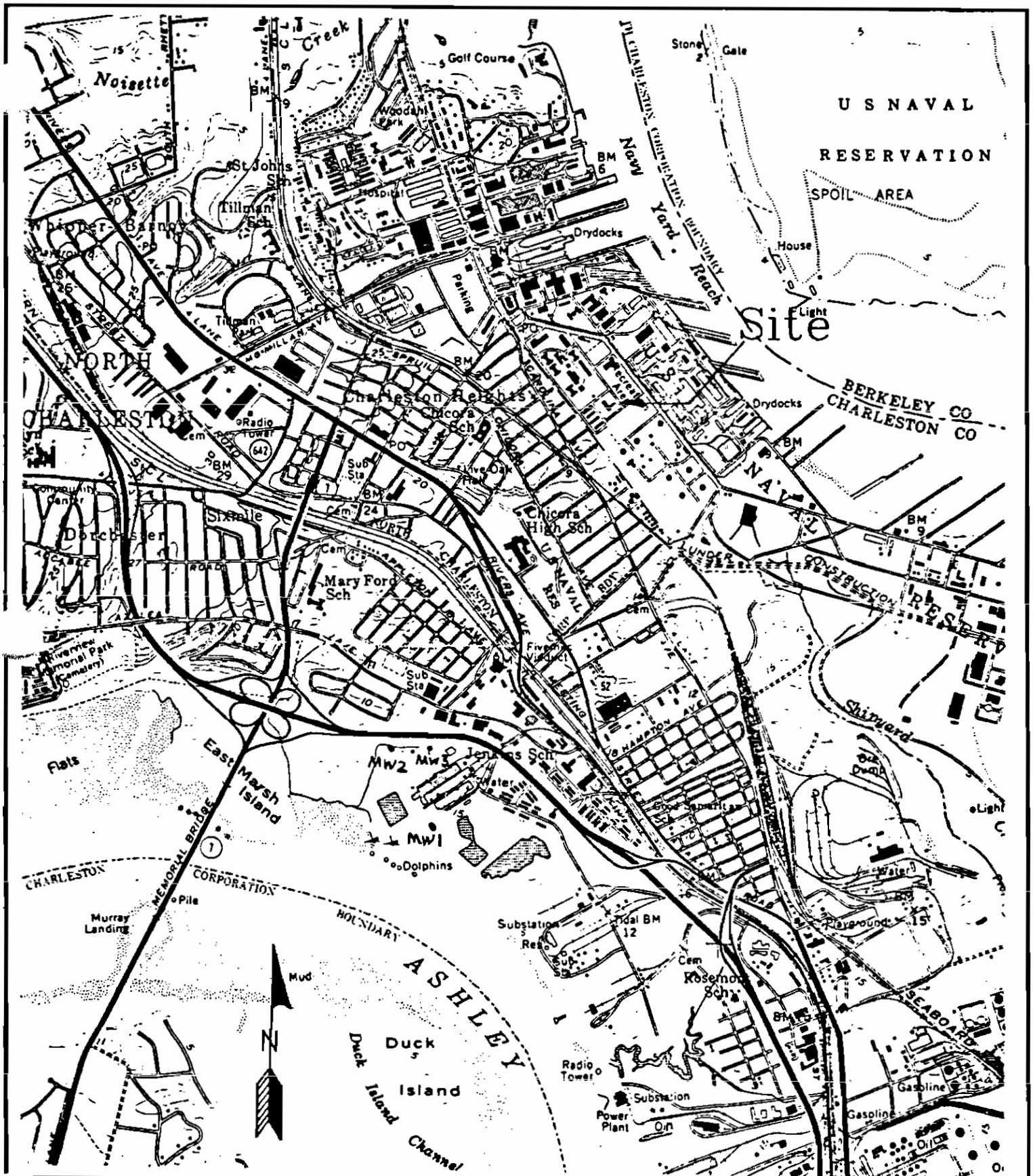
To assure that the system remains operational, periodic operation and maintenance (O&M) of the system will be conducted. This O&M program would include:

- tracking recovery efforts;
- arranging for periodic removal of free product from storage tank;
- maintenance/repair to ancillary equipment (compressor, etc.)
- adjusting recovery pumps;
- cleaning recovery pumps; and
- assuring overall system remains operational.

2.5 PRODUCT RECOVERY SYSTEM REPORTING

To document the free product recovery efforts, an initial free product recovery report will be prepared defining what efforts were taken to recover free product at the site. This report would at a minimum include as-built construction drawings of the trench and recovery system and a narrative of the recovery system installation and operation procedures.

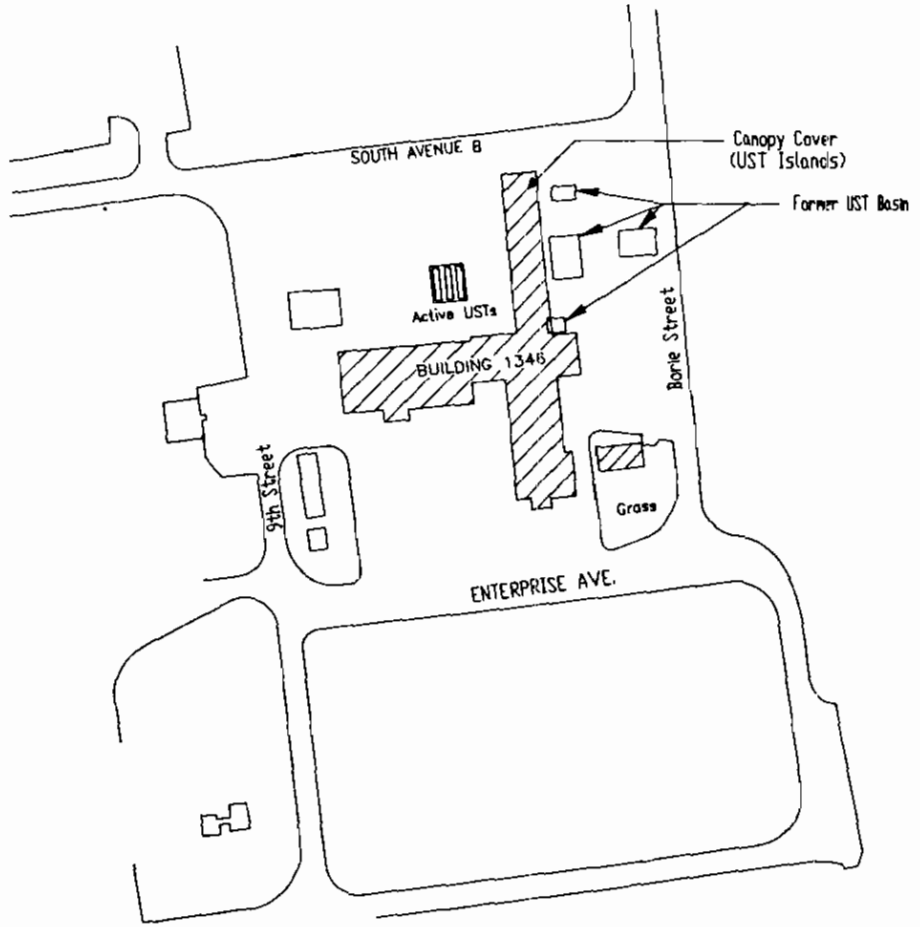
Upon installation and startup of the recovery system, quarterly reports would be prepared presenting the recovery progress for that quarter, any operational problems that had occurred and any modifications made to the system to enhance the recovery rate.



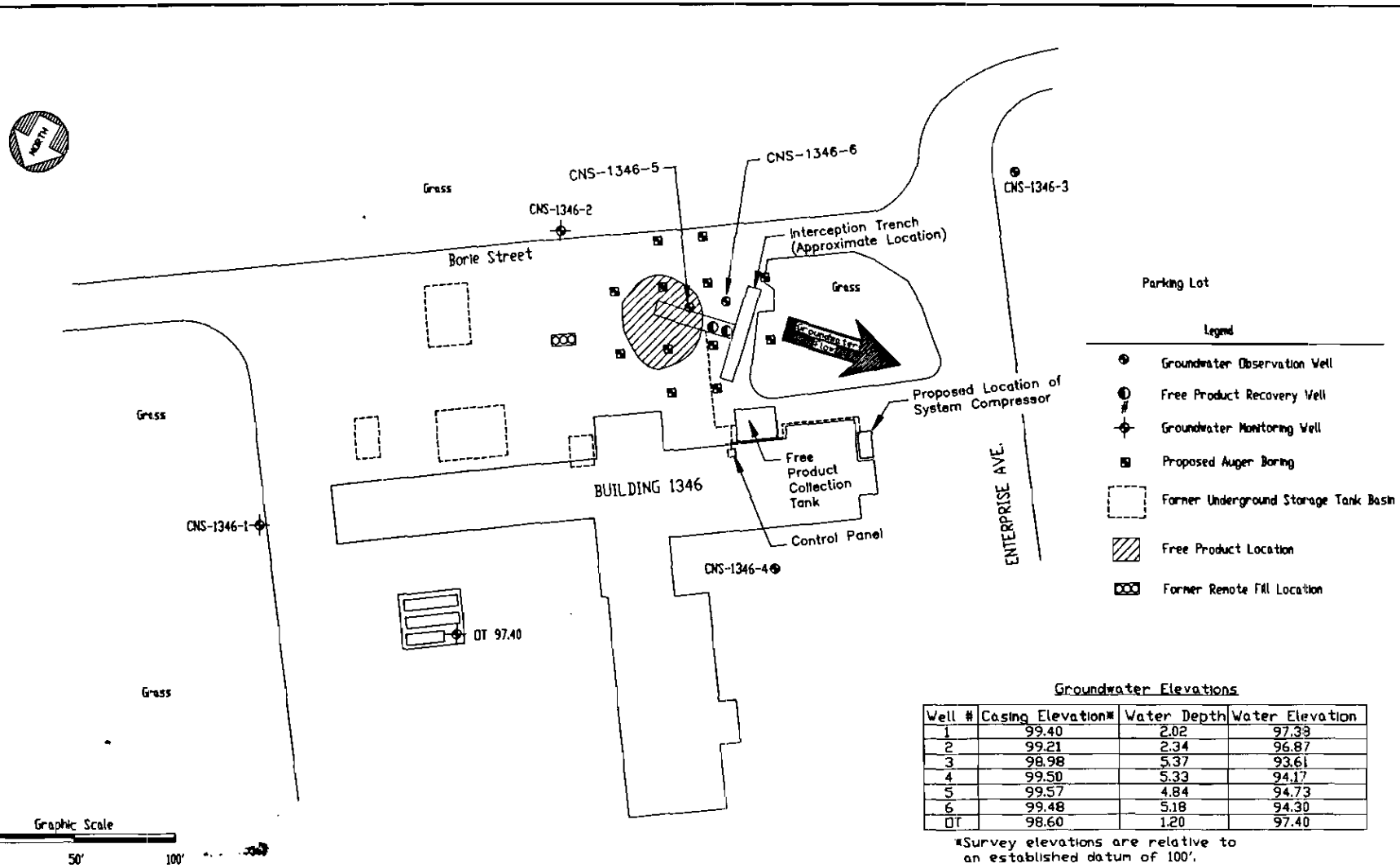
SCALE: 1" = 2000'	DRAWN BY: NA	S&ME Charleston Branch, 640 Low Country Blvd, Mt Pleasant, South Carolina 29464, (803) 884-0068	TITLE: Site Location Plan Free Product Recovery Plan Building 1346 Charleston Naval Base, S.C.
DATE: 08-12-93	CHECKED BY:
JOB NO: 1134-93-298	APPROVED BY:

FIGURE: 1

C:\ACAD\Blueline\A-FeeL098



SCALE: 1" = 50'	DRAWN BY: WJM	S&ME Charleston Branch 840 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005 ENVIRONMENTAL SERVICES • ENGINEERING • TESTING	TITLE: Site Plan Free Product Recovery Plan Building 1346 Charleston Naval Station Charleston, South Carolina
DATE: 8-9-93	CHECKED BY: [illegible]		FIGURE: 2
JOB NO: 1134-93-298	APPROVED BY: [illegible]		SHEET 2 OF 3



Groundwater Elevations

Well #	Casing Elevation*	Water Depth	Water Elevation
1	99.40	2.02	97.38
2	99.21	2.34	96.87
3	98.98	5.37	93.61
4	99.50	5.33	94.17
5	99.57	4.84	94.73
6	99.48	5.18	94.30
OT	98.60	1.20	97.40

*Survey elevations are relative to an established datum of 100'.

SCALE: 1" = 50'	DRAWN BY: WJM	S&ME Charleston Branch 640 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005 ENVIRONMENTAL SERVICES • ENGINEERING • TESTING	TITLE: Interception Trench Free Product Recovery Plan Building 1346 Charleston Naval Station Charleston, South Carolina
DATE: 8-9-93	CHECKED BY:		FIGURE: 3
JOB NO: 1134-93-298	APPROVED BY:		SHEET 3 OF 3

HYDROGEOLOGIC ASSESSMENT
BUILDING 1346
CHARLESTON NAVAL STATION
GWPD SITE ID #A-10-AA-14067
CHARLESTON, SOUTH CAROLINA

Prepared For:

Environmental Protection Division
Charleston Naval Shipyard
Charleston, South Carolina

Prepared By:

S&ME, INC.
840 Low Country Boulevard
Mount Pleasant, South Carolina 29464
(803) 884-0005

S&ME

February 19, 1993

Charleston Naval Shipyard
Environmental Protection Division
Code 106.2
Charleston, SC 29409

Attention: Mr. J.W. Sneed

Subject: Hydrogeologic Assessment Report
Building 1346
Navy Exchange Service Station
Charleston Naval Station
Charleston, SC
S&ME, Inc. Job #1134-92-067

Dear Mr. Sneed:

S&ME, Inc. (S&ME) is pleased to submit the following report for the above referenced site. This report has been prepared in accordance with our work plan dated July 26, 1991 and in response to the South Carolina Department of Health and Environmental Control (SCDHEC) correspondence dated May 8, 1991. S&ME is presently awaiting lab results for the worst case well analysis (due February 19, 1993). This information will be provided as an addendum to this report.

If you have any questions, please contact us at 884-0005.

Sincerely,

S&ME, INC.

Hugh J. Connolly
Project Hydrogeologist

John H. Albrecht, P.E.
Senior Environmental Engineer

HJC/JHA/sl

S&ME

February 18, 1993

South Carolina Department of
Health and Environmental Control
Groundwater Protection Division
2600 Bull Street
Columbia, SC 29202

Attention: Mr. Scott McInnis

Subject: Hydrogeologic Assessment
Building 1346
Charleston Naval Station
GWPD Site ID A-10AA-14067
Charleston, SC 29409-6100

Dear Mr. McInnis:

S&ME, Inc. (S&ME) is pleased to submit the following assessment report for the above referenced site. This report has been prepared in response to your letter dated May 8, 1991 responding to our UST Closure Assessment for the site dated March 21, 1991.

The following report has been prepared in accordance with our work plan dated January 28, 1992, submitted to the South Carolina Department of Health and Environmental Control (SCDHEC). If you have any questions concerning this report, please contact us at 884-0005.

Sincerely,

S&ME, INC.

Hugh Connolly
Project Hydrogeologist

John Albrecht, P.E.
Senior Environmental Engineer

HC/JA/sl

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1.0 INTRODUCTION

The subject site is a retail gasoline service station denoted as Building #1346 on the Charleston Naval Station in Charleston, South Carolina. A location plan for the site is presented as Figure 1. A site plan for the site is presented as Figure 2.

The Exchange Service Station presently has eleven Underground Storage Tanks (USTs) buried on-site. The first UST installed consisted of four 4,000 gallon steel USTs situated within the same tank basin, and one remotely located 10,000 gallon steel UST. These tanks were reported in a 1987, Harding Lawson Associates report as being installed at least 20 years ago. The tanks are listed as tanks 1346-D, E, F, G and H. All of the tanks were reported as storing gasoline, were constructed of steel and had steel piping. The tanks were abandoned at varying times ranging from 6 - 15 years ago.

With the abandonment of the five tanks, the site was retrofitted with three 10,000 gallon steel tanks numbered #1346-A, B and C. The tanks have steel piping and are used for storage of gasoline. Tank #1346-A was reportedly installed 11-15 years and tanks #1346-B and C were installed 6-10 years prior to the Harding Lawson Report. Two USTs, presumably tanks #1346-B and C, are situated within the same tank basin. The third UST is remotely located in an isolated tank basin to the north near the two northern most dispensing islands. The tanks #1346-A, B and C were taken out of operation in February 1991, following a failed tank tightness test. The former UST basins at the site are as shown on Figure 2. A detailed layout of the USTs formerly operational at the site was provided in S&ME's August 1991 submittal.

The site is presently operating with three new 10,000 gallon fiberglass tanks with single walled fiberglass piping. Two of the tanks have pressurized piping systems, while one of the tanks is a suction system. These tanks were installed in 1991.

As a result of the failed tank tightness test, S&ME was contracted to perform a Site Closure Assessment dated March 21, 1991, to measure for the presence of a release where contamination was most likely to be present. Analytical results for soil samples collected within the UST basins, along product piping, and at the pump island indicated the presence of petroleum hydrocarbon related contamination at varying levels confirming that a release had occurred.

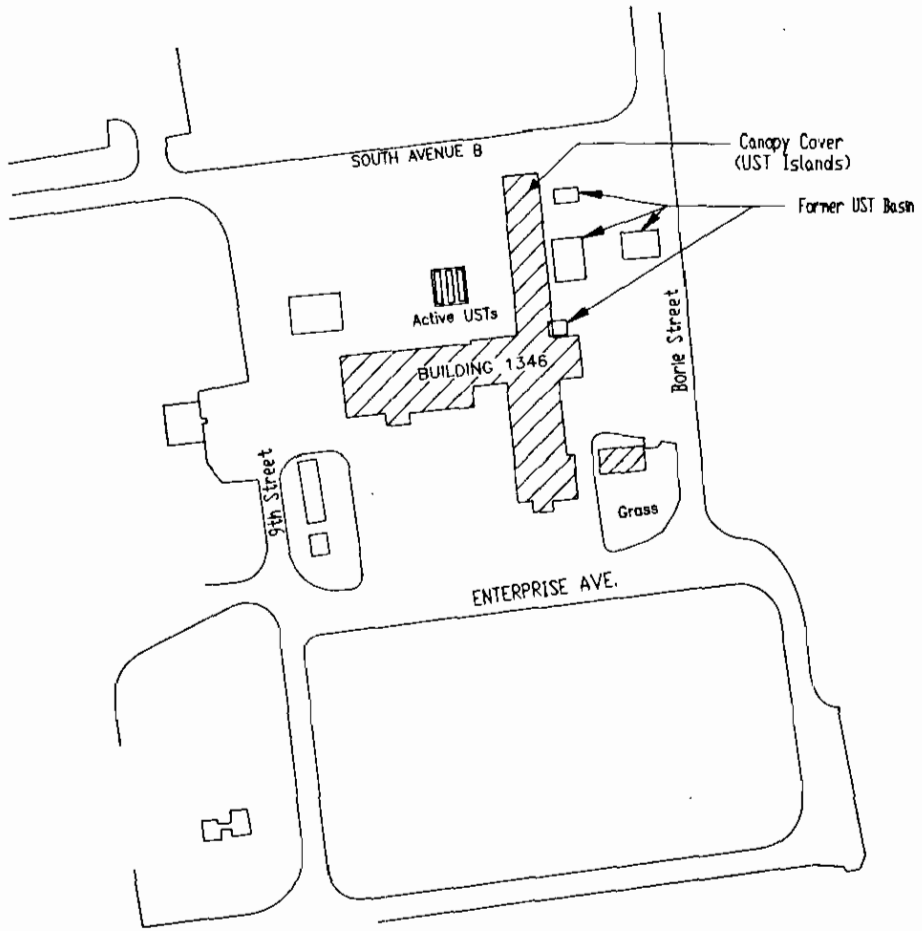
During the site closure assessment, additional soil samples were collected from proposed UST and pipeline locations at the site where additional USTs were to be installed. This was done in an attempt to determine if and to what degree, contamination may be encountered upon soil excavation resulting from new UST installations. Low level contamination was detected in the soil samples collected from the proposed UST and pipeline locations and as a result the excavated soil and groundwater resulting from the dewatering operations was required to be abated according to the South Carolina Department of Health and Environmental Control (SCDHEC) regulations, standards and guidelines. Shortly after the site closure assessment was submitted to the SCDHEC, the new USTs and piping at the site were installed and pumping operations were resumed.

The SCDHEC responded to S&ME's Site Closure Assessment in their correspondence dated May 8, 1991, requesting that a summary of the initial abatement actions, an initial site characterization, method of free product recovery, and an assessment plan addressing the potential for groundwater impact be submitted. This report dated August, 1991 was prepared and submitted to the SCDHEC.

A soil/groundwater assessment plan was incorporated to this report for which approval to implement was granted in the SCDHEC correspondence dated January 28, 1992. The following report details S&ME's investigative work performed at the site in accordance with our work plan dated August 7, 1992.

Note: This Site Location Plan was derived from a USGS Charleston Quardrangle South Carolina 7.5 Minute Series (Topographic) Photorevised 1979.

SCALE: 1" = 2000'	DRAWN BY: NA	S&ME Charleston Branch 540 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005 ENVIRONMENTAL SERVICES · ENGINEERING · TESTING	TITLE: Site Location Plan Hydrogeologic Assessment Building 1346 Charleston Naval Station Charleston, South Carolina
DATE: 02-15-93	CHECKED BY: MC		FIGURE: 1
JOB NO: 1134-92-069	APPROVED BY:		1 OF 6



Graphic Scale

0' 50' 100'

SCALE:	1" = 50'	DRAWN BY:	WJM
DATE:	02-15-93	CHECKED BY:	H.R.
JOB N	34-92-069	APPROVED BY:	JHR

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING

Charleston Branch
840 Low Country Blvd.
Mt Pleasant, South Carolina
29464
(803) 884-0005

TITLE: Site Plan
Hydrogeologic Assessment
Building 1346
Charleston Naval Station
Charleston, South Carolina

FIGURE: 2

SHEET 2 OF 8

2.0 SITE GEOLOGY/HYDROGEOLOGY

Building #1346 is located within the confines of the Lower Coastal Plain Physiographic Province of South Carolina. Generally, the Coastal Plain Province is characterized by a successively overlapping wedge of sediments which forms a thin layer near the fall line and thickens to about 3000 feet in Southern Charleston County.

Sediments encountered while performing the soil vapor survey and well installations on site include surficial fill material black to grey green silty clays that are lagoonal sediments characteristic of back barrier island sequences. Soft grey green clays are generally encountered down to the Cooper Formation.

The Cooper Formation (Eocene Age), specifically the Cooper Marl, was encountered at the site at a depth of 29 feet below land surface. Although it has some water bearing capacity, the Cooper Formation is regarded as a confining unit for the overlying shallow aquifer systems and as an aquitard protecting the underlying primary water bearing units.

Traversing from east to west across the site, the surficial soils (upper 8 feet) grade to dense red clays (area of CNS-1346-5) with a slight increase in silt content as compared to the eastern end of the site. Below 8 feet, the dense grey green clays are again encountered.

Based upon data from measurements and tests performed upon the wells installed by S&ME at the site, the groundwater flow direction is from east to west across the site. This is evidenced by the spread of the contaminant plume along Borie Street identified by the soil vapor survey.

Data taken from the potentiometric surface map for the site indicates a horizontal gradient of 0.02 feet/feet. When applied to the horizontal hydraulic conductivity (~25 feet/day), the linear flow velocity was calculated to be 1.7 feet/day or 608 feet/year. This number is relatively high based upon the expected low permeability, clay soils at the site; however, based upon the increased amount of rainfall in the Charleston area in the past few months and the grassed fields bounding the site to the south and east, it is felt that the groundwater table in the areas of well numbers CNS-1346-1 and CNS-1346-2 has been elevated due to

increased infiltration of precipitation in these areas. Due to the increased infiltration the horizontal hydraulic gradient has been increased. The restricting permeability of the clay soils has maintained a higher water table elevation at the infiltration areas of the site.

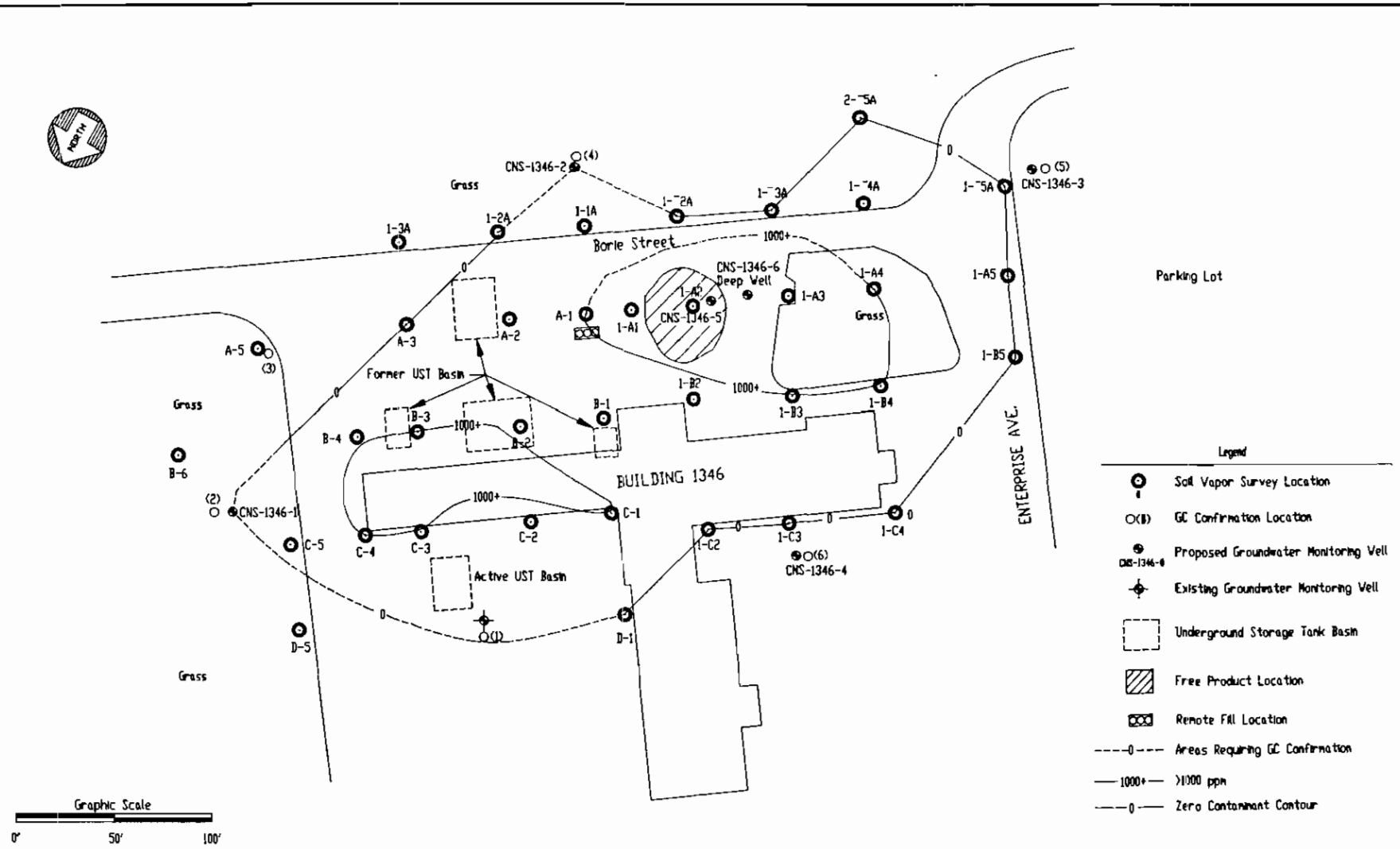
The vertical hydraulic gradient of the site was calculated to be 0.027ft/ft. Based upon the differences in elevation of the deep well (CNS-1346-6) as compared to the paired shallow well (CNS-1346-5), the area is considered a recharge area and the groundwater would have a tendency to migrate vertically downward with horizontal migration.

3.0 SOIL SURVEY

Our original work plan proposed to conduct the soil vapor survey by driving a 3/8" carbon steel rod approximately 3.5 feet below grade within a specific grid location established on 50 feet centers. However, due to the dense clays of high natural organic and moisture content making up most of the site, this method proved ineffective, resulting in erroneous readings from the Photo Ionization Detector (PID). As a result, hand auger borings were performed in each grid location. Soil samples were collected at two foot intervals down to the soil/groundwater interface at that time encountered at a depth of six feet below grade. These samples were then bagged and a headspace analysis performed utilizing a flame ionizing organic vapor analyzer (OVA). Due to the high levels of natural organics encountered at the site, the OVA was fitted with a charcoal filter to aid in screening natural organic vapors. The charcoal filter would screen out the petroleum hydrocarbons (low level) and allow the OVA to read only the methane concentrations (natural organics). The methane readings were then subtracted from the total organic concentrations (headspace reading without charcoal filter) yielding a representative petroleum hydrocarbon concentration.

Although the charcoal filtration technique utilized in conjunction with the OVA aided in determining the contaminant levels for the soil samples collected, S&ME felt that some of the natural organics were still being detected, hindering the determination of actual contaminant levels. As a result, several locations (i.e. well locations) were also sampled and subjected to analysis by our portable gas chromatograph for benzene, toluene and xylene concentrations. The results of the vapor survey, showing a 1000+ part per million and a zero contaminant contour are shown on Figure 3.

As defined by the soil vapor survey, two main areas of contamination were detected at the site yielding OVA readings greater than 1,000 ppm. One area appears to be associated with the UST basins and pump islands located on the eastern half of the site. Although this area of the site is characterized by the naturally occurring organics, samples collected in the 1,000+ ppm area possessed distinct petroleum hydrocarbon (gasoline) odors.



SCALE:	1" = 50'	DRAWN BY:	WJM
DATE:	02-15-93	CHECKED BY:	HJC
JOB N°	34-92-069	APPROVED BY:	

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING

Charleston Branch
840 Low Country Blvd,
Mt Pleasant, South Carolina
29464
(803) 884-0005

TITLE: Soil Vapor Survey
Hydrogeologic Assessment
Building 1346
Charleston Naval Station
Charleston, South Carolina

FIGURE: 3

SHEET 3 OF 8

Due to the natural organics occurring at this portion of the site, the zero contour was established based upon OVA readings, physical observations (odor) and confirmation using our portable gas chromatograph. Background soil samples were collected from a grassed field adjacent to the site to the east. Two samples were collected, along "B" row at 100 and 200 feet east of Building 1346. Similar OVA readings were obtained from soil samples collected at the soil groundwater interface (i.e. location B-6 at a level of 150 ppm). Similar levels were obtained from sample location A-5 (170 ppm). Location A-5 was resampled and analyzed by portable GC and no BTX constituents were detected confirming the 170 ppm detected by OVA was natural organic concentrations. As a result, soil samples were collected along the zero contaminant contour in this area of the site for GC confirmation. The zero contour is represented by a dashed line in these areas. The soil samples subjected to GC analysis are denoted on Figure 3 by the identifying symbol in the legend followed by a number in parenthesis.

The second 1,000+ ppm area identified by the soil vapor survey occurs on the opposite side of the site relative to the UST basins and pump islands. Within this area, an isolated pocket of free product (gasoline) was identified. The free product was identified in sample location 1 - A2. Due to the observation being made through an open borehole, S&ME was unable to make an accurate gauge as to the thickness of the product; however, product thickness greater than 10 inches was observed. The product was not present in the adjacent sample locations indicating the product is only located within 50 feet of location 1-A2. The sample locations westward past the free product location were significantly contaminated yielding OVA readings greater than 1,000 ppm (locations 1-B3, 1-A3 and 1-A4). Beyond these locations to the north and west, no contamination was detected by the OVA headspace analysis. To the east elevated readings were obtained from location 1 - -2A and 1 - -3A. Significant OVA readings as well as odors were noted in sample number 1 - -4A. As a result sample 2 - -5A was collected. No OVA readings or odors were noted within this sample.

To ensure proper well placement defining the horizontal limits of the contaminant plume and to confirm zero line locations at the northeast area of the site, S&ME collected soil samples for analysis by our portable GC. A total of six samples were collected. The sample locations are shown on Figure 3 and are denoted by the symbol identified in the legend followed by a number in parentheses. Sample number (1) was collected adjacent to an existing groundwater monitoring well associated with the new active tank basin recently constructed at the site. Low level benzene concentrations were detected in this sample at a level of 1.6 ppb. As a result, S&ME incorporated the existing well into the assessment at the site. Sample number (2) was collected from proposed well location (CNS-1346-1) to define the limits of contamination in this area. Only 5 ppb Toluene was detected in the sample. Sample number (3) was collected adjacent to vapor survey location A-5 for comparison of OVA to GC results as explained earlier. Sample (4) was collected from proposed well location CNS-1346-2 and for confirmation of the zero contamination contour. Sample number (5) was collected from proposed well location CNS-1346-3. Sample number (6) was collected from proposed well location CNS-1346-4.

The previously described soil vapor survey efforts were submitted in a well request letter to the SCDHEC requesting permission to install 5 shallow and one deep groundwater monitoring well at the site. Approval to install the wells was granted in the SCDHEC correspondence dated November 18, 1992.

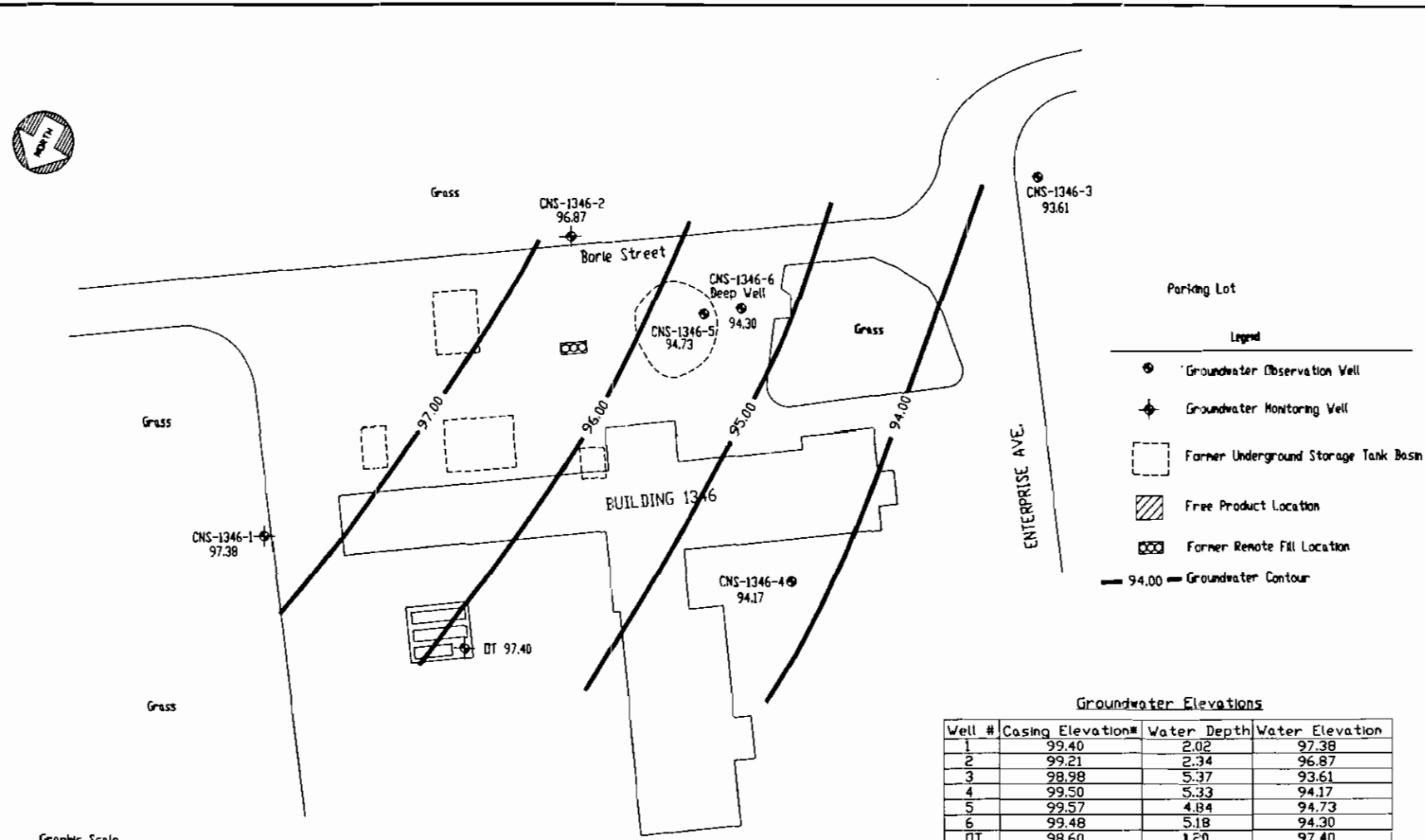
4.0 GROUNDWATER MONITORING WELL INSTALLATION

S&ME installed a total of 5 shallow and one deep groundwater monitoring wells at the site. The locations of these wells are shown on Figure 4. The Water Well Record forms for the wells installed at the site are included as Appendix I.

4.1 Shallow Well Installation

The shallow wells were constructed by augering a 6-inch diameter hollow stem auger into the subsurface to a depth of approximately 5-feet below the existing groundwater table. The boreholes were converted to monitoring wells by the installation of a 2-inch diameter, Schedule 40 PVC casings and screens. The screen length in each well was 10-feet and had a factory number 10 slot size (0.010 inches). A clean coarse washed filter sand (FX-50) was installed by tremie to a depth of approximately 1.5-feet above the top of the screens. A bentonite pellet seal, one foot thick, was installed above the filter sand. The remaining annulus of the wells were then filled with a neat cement grout. The tops of the wells were finished below grade in a protective vault set in a 2-foot square by 6-inch thick concrete pad and equipped with locking caps. Figure 5 presents a typical well construction diagram for the shallow wells.

The 4-inch diameter well was installed in similar fashion; however due to the size of the 4-inch PVC casing and screen, a 10.25 diameter hollow stem auger was utilized for the installation. Also, the overall depth of the well was adjusted so the screen was properly placed allowing the expected free product to be bracketed within the screened portion of the well.



Groundwater Elevations

Well #	Casing Elevation*	Water Depth	Water Elevation
1	99.40	2.02	97.38
2	99.21	2.34	96.87
3	98.98	5.37	93.61
4	99.50	5.33	94.17
5	99.57	4.84	94.73
6	99.48	5.18	94.30
OT	98.60	1.20	97.40

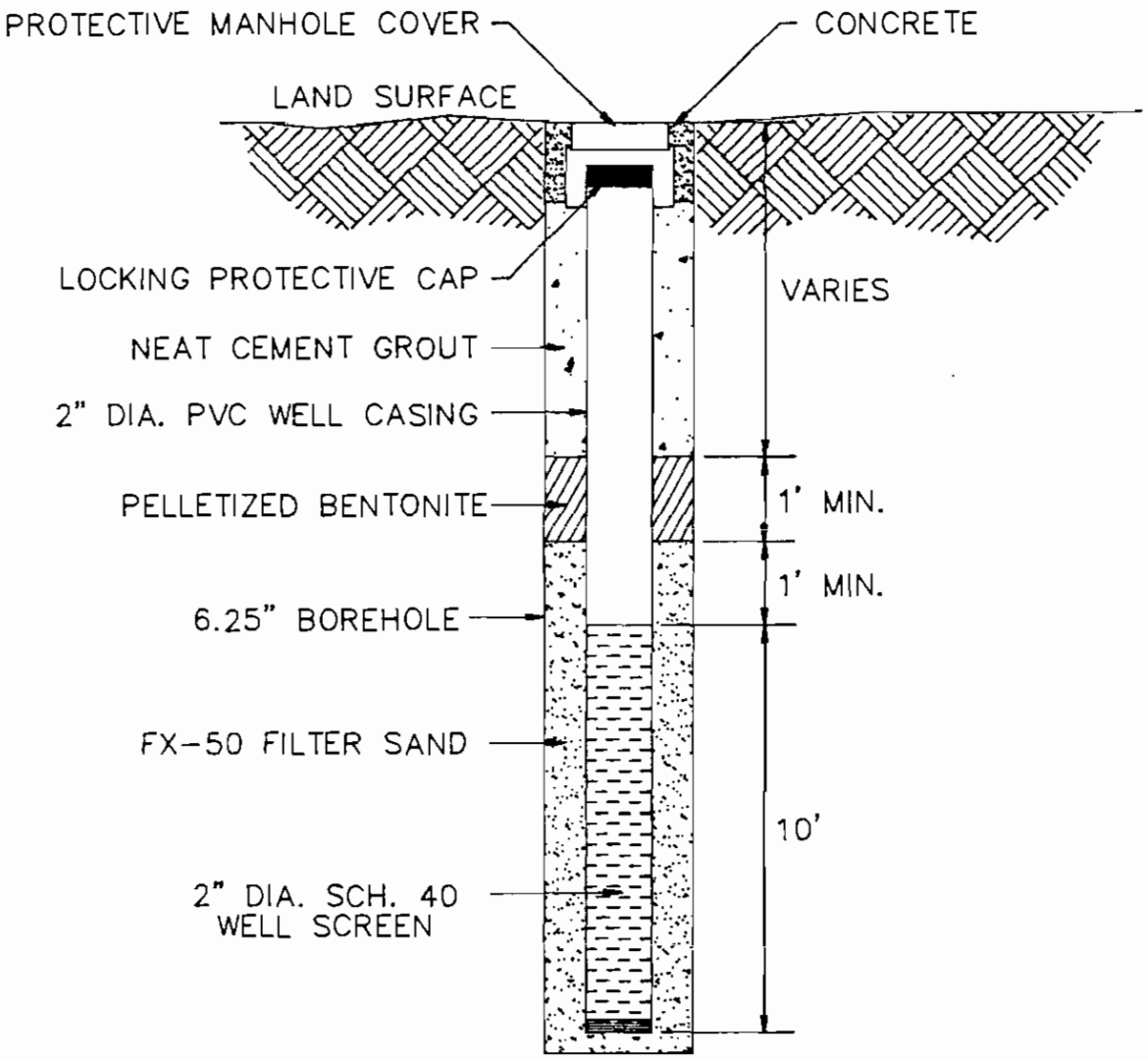
*Survey elevations are relative to an established datum of 100'.

SCALE: 1" = 50'	DRAWN BY: WJM	S&ME ENVIRONMENTAL SERVICES - ENGINEERING	Charleston Branch 840 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005
DATE: 02-15-93	CHECKED BY: HJC		
JOB N/ 94-92-069	APPROVED BY:		

TITLE: Potentiometric Surface Map
Hydrogeologic Assessment
Building 1346
Charleston Naval Station
Charleston, South Carolina

FIGURE: 4

SHEET 6 OF 6



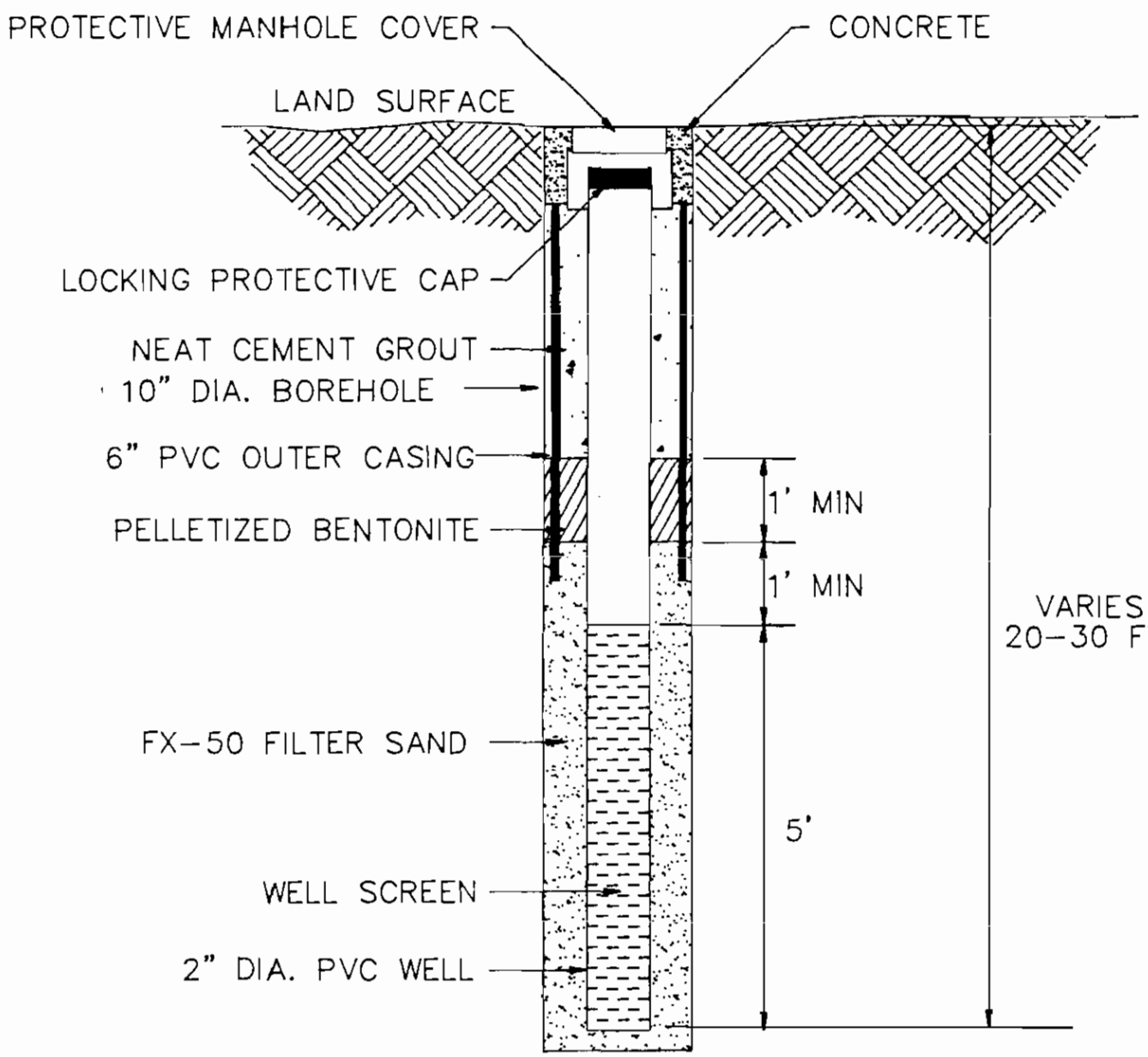
SHALLOW GROUNDWATER MONITORING WELL
TYPICAL CONSTRUCTION DETAILS
(BELOW-GRADE COMPLETION)

SCALE: No Scale	DRAWN BY: WJM	S&ME ENVIRONMENTAL SERVICES · ENGINEERING · TESTING Charleston Branch 840 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0008	TITLE: Shallow Well Construction Diagram Hydrogeologic Assessment Building 1346 Charleston Naval Station Charleston, South Carolina	FIGURE: 5
DATE: 02-15-93	CHECKED BY: HJC			
JOB NO: 1134-92-069	APPROVED BY: [illegible]			5 OF 6

4.2 Deep Well Installation

To minimize the potential for the introduction of petroleum related contaminants from the upper portion of the shallow aquifer, the deep well was installed in a telescoping manner. Initially a 8-inch diameter auger hole was advanced to a depth of 13 feet below land surface. A 6-inch diameter PVC casing was then set to the approximate depth of the pair shallow well (CNS-1346-5 @ 12') and grouted in place. Twenty-four hours later, the 6-inch casing was bored with a 5 and 7/8-inch drag bit by mud rotary to 29-feet below the land surface (Depth to Marl). The well was set by placing 1-foot of sand pack at the bottom of the well and then lowering 5-feet of #10 slotted (0.010 inches) PVC well screen and 24-feet of PVC riser. FX-50 sand was tremied around it from 29 to approximately 22-feet below land surface. A bentonite seal was then placed above the sand to 12 feet below grade. The remaining annulus of the well was filled with neat cement grout. The top of the well was set in a 2 feet square concrete pad and fitted with a water tight manhole cover and locking cap. A construction diagram of a deep well is provided in Figure 6. Prior to and in between each well installation, the drilling equipment was steam cleaned and scrubbed with a chemically neutral surfactant and rinsed with deionizing water.

The drill cuttings from the well installations were drummed and labeled to identify what cuttings resulted from each well. The drilling fluids from the rotary drilling were also drummed.



TYPICAL DEEP-WELL-CONSTRUCTION DETAILS
(BELOW-GRADE COMPLETION)

SCALE: None	DRAWN BY: WJM	S&ME Charleston Branch, 640 Low Country Blvd, Mt Pleasant, South Carolina 29464 (803) 884-0005	TITLE: Deep Well Construction Diagram Hydrogeologic Assessment Building 1346 Charleston Naval Station Charleston, South Carolina	FIGURE: 6
DATE: 02-15-93	CHECKED BY: HJC			
JOB NO: 113492069	APPROVED BY:			6 OF 6

5.0 GROUNDWATER MONITORING WELL DEVELOPMENT/SAMPLING/ANALYSIS

Prior to development and sampling, a minimum of 24 hours was allowed for the grout seals in the wells to become competent. A minimum of 10 well volumes was purged from each well to ensure development and seating of the gravel pack filter. The development water was contained in 55 gallons drums and stored on site awaiting disposal.

The groundwater samples were collected by disposable bailers, brought to the site in factory sealed containers. As the samples were collected, they were placed into specially prepared sample containers and immediately refrigerated. Upon completion of all sample collections, the samples were delivered by overnight courier to Hydrologic Laboratories in Columbia, South Carolina. Also, an observation tube in the active tank basin was included in the sampling event.

The samples were analyzed for Total Petroleum Hydrocarbons (TPH) by Gas Chromatography (GC) Method 5030, and Benzene, Toluene, Elthylbenzene and Xylene and Methyl Tert Butyl-Ether (MTBE) by EPA Method 602.

Our original work plan proposed to perform Total Lead upon the groundwater samples collected from the site, however the most recent SCDHEC Guidelines for UST Assessments dated January 22, 1993 no longer requires total lead analysis on groundwater samples other than the worst case well, and as a result, the analysis was not performed.

Due to its location within the free product area, well number CNS-1346-5 was determined to be the worst case well. As a result this well was also analyzed for Total and Dissolved lead, Purgeable Halocarbons by EPA Method 601 and 5 day Biochemical Oxygen Demand (BOD_5).

In addition to the well sampling at the site, composite soil samples were collected from the drummed soil cuttings at the site. Two composite samples were collected and analyzed for BTEX by EPA Method 8020 and TPH by GC (5030). Sample C-5 and 6 was collected from the soil cuttings resulting from well numbers CNS-1346-5 and 6 installed in the free-product area. Sample C-1, 2, 3, 4 was collected from the soil cuttings resulting from the installation of well numbers CNS-1346-1, CNS-1346-2, CNS-1346-3, CNS-1346-4.

6.0 ANALYTICAL RESULTS

As was expected, no petroleum related contamination was detected in perimeter wells CNS-1346-1,2,3 and 4. However, significant levels of contamination were detected in the worst case well CNS-1346-5 and in the observation tube within the active tank basin. No BETX constituents were detected in the deep well (CNS-1346-6) installed at the site; however significant levels of MTBE were detected in this well.

Significant levels of contamination were detected in the soil samples collected from the drill cuttings resulting from well numbers CNS-1346-5 and CNS-1346-6. However, only minor levels were detected in the soil sample collected from the drill cuttings resulting from the installation of well numbers CNS-1346-1, CNS-1346-2, CNS-1346-3 and CNS-1346-4.

The following Table 1 summarizes the constituents detected by the soil and groundwater analysis performed and the EPA's Drinking Water Maximum Contaminant Levels (MCLs) for those constituents analyzed. The analytical results are included as Appendix II.

Presently, S&ME is awaiting the results for the Total and Dissolved lead, the BOD_5 and EPA Method 601 analyses performed upon the worst case well. The results are due on February 19, 1993 and will be provided as an addendum to this report. These results are for treatment system design should have no significant impact as to the conclusions of the report.

TABLE 1
SUMMARY OF ANALYTICAL RESULTS

	WELL # CNS-1346-								SOIL	
PARAMETER	# 1	# 2	# 3	# 4	# 5	# 6	OT	MCL	C-5,6	C-1,2,3,4
TPH *(ppm)	**<0.1	<0.1	<0.1	<0.1	23.4	<0.1	<0.1	NE***	150	<0.1
BENZENE ****(ppb)	<2.5	<2.5	<2.5	<2.5	23300	<2.5	863	5	23000	<6.0
TOLUENE (ppb)	<2.5	<2.5	<2.5	<2.5	36400	<2.5	27.1	1000	146000	27.9
ETHYLBENZENE (ppb)	<2.5	<2.5	<2.5	<2.5	4140	<2.5	124	700	50000	6.78
XYLENES (ppb)	<7.5	<7.5	<7.5	<7.5	18900	<7.5	47.5	10,000	183000	48.7
MTBE (ppb)	<50	<50	<50	<50	92900	130	180	NE	4290	<50

* ppm = part per million
** <# = constituent not detected above analytical quantitation limit
*** NE = none established
**** OT = Observation tube in active tank basin
***** ppb = part per billion

7.0 SURFICIAL AQUIFER CHARACTERIZATION

The following sections of this report describe S&ME's methodology and calculation procedures for characterizing the surficial aquifer at the study site.

7.1 Potentiometric Surface

Groundwater at the study site is encountered at a depth of 2 feet at the east end of the site to 5 feet below grade at the west end of the site.

Prior to performing the hydraulic conductivity tests, water level measurements were obtained from each well. This information was then applied to a scaled site plan and a potentiometric surface map produced. Table 2 summarizes the water table elevations.

Well number CNS-1346-5 is installed in a known free product area; however, to date only a minor amount of product has been noted in this well. Presently, S&ME plans to conduct additional development by "surge blocking" the well in an attempt to enhance the flow of the product for recovery efforts. This technique may prove ineffective and recovery may have to be facilitated by trench installation.

TABLE 2
GROUNDWATER ELEVATION DATA
HYDROGEOLOGIC ASSESSMENT
BUILDING 1346
CHARLESTON NAVAL STATION
CHARLESTON, SOUTH CAROLINA

WELL #	TOP OF CASING (FT.)	DEPTH TO WATER (FT.)	ELEVATION (FT.)*
CNS-1346-1	99.40	2.02	97.38
CNS-1346-2	99.21	2.34	96.87
CNS-1346-3	98.98	5.37	93.61
CNS-1346-4	99.50	5.33	94.17
**CNS-1346-5	99.57	4.84	94.73
**CNS-1346-6	99.48	5.18	94.30
**OT	98.60	1.20	97.40

* Elevation relative to an established datum of 100'.

** Due to the differences in well designs the data from these wells was used in the production of the potentiometric surface map.

7.2 Hydraulic Conductivity Tests

Field hydraulic conductivity tests (slug tests) were performed upon well numbers CNS-1346-1, CNS-1346-3, CNS-1346-4, AND CNS-1346-6. The slug tests were performed utilizing a Hermit 2000 Series data logger in conjunction with an In-Situ™ stainless steel 5 psi pressure transducer fitted with teflon shielding. The pressure transducer was set at a depth of 5 feet below the water surface. A length of 1 inch diameter black PVC tubing fitted with a check valve was placed in the well to the approximate depth of the transducers. The equipment was then allowed to stand for a brief period until instrumentation indicated that the static conditions had once again been achieved. The black PVC tubing was then quickly withdrawn removing the required slug of water and the rate of recharge into the well was recorded by the data logger. Prior to and inbetween each slug test performed, the field testing equipment placed within the wells was decontaminated with a chemically neutral surfactant and rinsed a minimum of three times with deionized water.

Upon collection of the field data, the information collected by the data logger was downloaded to a computer which generated data tables showing drawdown versus time. This information was then graphed on semi-log paper. Information obtained from the graph was then input to software calculating the hydraulic permeability (Kh) by the Bouwer and Rice Method (1976).

Table 3 lists the calculated conductivities for the wells tested. Data tables, graphs and computer calculation sheets listing the parameter variables are provided in Appendix III.

The results obtained from the hydraulic conductivity testing are considered reasonable based on our experience. The low number resulting from the testing performed upon the deep telescoping well CNS-1346-6 was expected due to the screened portion of the well being set in the lower portion of the surficial aquifer in the upper portion of the Cooper Marl.

TABLE 3

SLUG TEST RESULTS
BUILDING 1346
CHARLESTON NAVAL STATION
CHARLESTON, SOUTH CAROLINA

WELL #	HORIZONTAL HYDRAULIC CONDUCTIVITY
CNS-1346-1	25 feet/day
CNS-1346-3	29 feet/day
CNS-1346-4	21 feet/day
CNS-1346-6	0.63 feet/day

7.3 Site Gradients/Linear Flow Velocity

For the purposes of determining the rate of groundwater flow slug test data from the deep well (CNS-1346-6) was not used.

An average hydraulic gradient of 0.02 ft/ft for the site was calculated using horizontal distance and groundwater elevation data. A modified form of Darcy's Law was then used to calculate the average linear flow velocity (Freeze and Cherry, 1979). This velocity was calculated using the following:

$$V = \frac{k}{n}\frac{dh}{dl}$$

where V = Average linear flow velocity
K = hydraulic conductivity (Average of Slug Test Results, 25 ft/day)
$\frac{dh}{dl}$ = $\frac{\text{Change in hydraulic head}}{\text{Change in distance}}$ = horizontal hydraulic gradient
n = Effective porosity

From available data, the average linear flow velocity was calculated to be 1.76 ft/day or
608 ft/year assuming an effective porosity of 40% based upon the clayey soils at the site.

The vertical gradient was calculated using the water table elevation from CNS-1346-6 the water table elevation from CNS-1346-5 and the depth at which the base of the screen sections were set for each well. Utilizing this data, the vertical gradient was calculated to be 0.027 ft/ft. Also, due to the fact that the water level in the deep well CNS-1346-6 is lower than that of the paired shallow well CNS-1346-5 indications are that this is a recharge area and groundwater is migrating downward from the surface of the aquifer to the lower limits of the aquifer (29 feet below grade) as the groundwater migrates horizontally with the preferred groundwater flow direction. This is confirmed by discovery of MTBE detected in the deep well CNS-1346-6 because MTBE typically precedes the edge of petroleum plumes. The calculations performed to obtain the data in this section are provided as Additional Calculations in Appendix III.

8.0 CONCLUSIONS/RECOMMENDATIONS

Based upon the analytical results for the worst case well (CNS-1346-5), a significant groundwater impact has occurred at this site. The impact has been identified in the deep well as well as in the observation tube within the active tank basin located at the opposite side of the site relative to the deep well and paired worst case well. Based on our conversations with Mr. Harry Harris, the service station manager, no loss in product has been recorded by the active tank basins Veeder Root automatic gauge system. As a result, it is likely the detected contaminant in this area is due to a release from the former UST's once active at the site.

Based upon the contamination in the tank basin and the verified groundwater flow direction, S&ME recommends that two additional shallow wells be installed as a final assessment stage at the site. One well should be installed north of the active tank basin and a second well should be installed directly down gradient of the groundwater flow direction (along Enterprise Avenue) to document the absence of contamination in these areas.

Upon completion of these additional well installations, the project should be moved to Corrective Action phase for soil and groundwater remediation.

Due to the absence of product in the worst case well, CNS-1346-5, additional development efforts need to be performed to determine if the product can be recovered in this fashion. These efforts should include surge blocking or air sparging to attempt to facilitate flow to the recovery well. Based upon the clay nature of the soils at the site, a recovery trench may be required as a alternate method of free product recovery.

With regard to the contaminated water drummed at the site, this water should be disposed as a special petroleum contaminated waste based upon the analytical results for the worst case well analysis.

Based upon the analytical results for the soil samples collected from the drummed soil cuttings at the site, the cuttings resulting from well numbers CNS-1346-5 and CNS-1346-6 should be treated prior to disposal. Incineration is recommended. The soil resulting from the other wells as well as the deep well grout material should not require any special handling practices for disposal (S&ME recommends disposal in a sanitary type landfill).

9.0 BIBLIOGRAPHY

Bouwer, H. and R.C. Rice. "A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells". Water Resources Research, V.12 (1976), 423-428.

Freeze, Allen R., John H. Cherry. Groundwater; Englewood Cliffs: Prentice Hall, Inc., 1979.

APPENDIX I

WATER WELL RECORD FORMS

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 758-5213 | Water Well Record

LOCATION OF WELL

County: Chas. System Name: CNS-1346-1

Latitude: 32°51'22" Longitude: 79°57'51"

Distance And Direction from Road Intersections: 100 feet North of Borie St. and South Ave B.

Street address & City of Well Location:

Sketch Map: (See example on back)

See figs. 1 and 4 of this report

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	*THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
0'- Top Soil	1'	1'
Grey Silty Clay	10'	11'
▽ at 2'		

*Indicate water bearing zones (use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL
Address: Charleston Naval Shipyard, Environmental Protection Division, Code 106.2
Telephone No: Charleston, SC (803) 743-5519

Engineer Address: S+ME Inc., 940 Low Country Blvd, Mt. Pleasant, SC 29464
Telephone No: (803) 884-0005

5. WELL DEPTH (Completed) 11 ft. Date Started 1-6-93 Date Completed 1-8-93

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE ☐ Domestic ☐ Public Supply Permit No ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Groundwater Monitoring Well

8. CASING ☒ Threaded ☐ Welded
Diam 2" Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in to 1 ft. depth
in to ft. depth
Height Above/Below Surface ft
Weight lbs./ft
Drive Shoe? ☐ Yes ☒ No Level w/Grade

9. SCREEN Type PVC Diam 2"
Slot/Gauze 0.010 Length 10'
Set Between 11 ft. and 1 ft.
ft. and ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10. STATIC WATER LEVEL 2.02 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
NA ft. after hrs. pumping G.P.M.
Pumping Test ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results See Appendix II

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 11 ft. to 0.5 ft.
Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? ☒ Yes ☐ No
Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☒ 0.5' Bentonite
Depth From 1 ft. to 0 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION 100 Feet East Direction
UST Type Well disinfected upon completion ☐ Yes Type ☒ No Amount

16. PUMP Date Installed NA ☐ not installed
Mfr. name model no.
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: S+ME Inc
ADDRESS: 840 Low Country Mt. Pleasant, SC
Henry Heschle III
CERT. NO. 1049
Signed AUTHORIZED REPRESENTATIVE
Date 2/18/93

DHEC Exp 96 (1/85) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 758-5213 **Water Well Record**

1. LOCATION OF WELL

County: Chas. System Name: CNS-1346-2

Latitude: 32° 51' 22" Longitude: 79° 57' 51"

Distance And Direction from Road Intersections: 100' East of Enterprise and Bcrie St.

Street address & City of Well Location

Sketch Map (See example on back): See figs. 1 and 4 of this report

2. CUTTING SAMPLES Yes [✓ No]

Geophysical Logs Yes (Please enclose) No

FORMATION DESCRIPTION	*THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
TOP SOIL	1'	1'
Grey Silty Clay	10'	11'
▽ at 2'		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL Address: Charleston Naval Shipyard, Environmental Protection Division, Code 106.2, Charleston, SC

Telephone No (803) 743-5519

Engineer Address: S+ME Inc. 840 Low Country Blvd, Mt. Pleasant, SC 29464

Telephone No (803) 884-0005

5. WELL DEPTH (Completed) 11 ft. Date Started 1-6-93 Date Completed 1-8-93

6. Mud Rotary / Jetted / Bored / Dug / Air Rotary / Driven / Cable tool / Other

7. USE Domestic / Public Supply Permit No. ____ / Industry / Irrigation / Air Conditioning / Commercial / Test Well / [✓ Groundwater Monitoring Well]

8. CASING [✓ Threaded] Welded

Diam. 2"

Type [✓ PVC] Galvanized Steel Other

2 in to 1 ft. depth

____ in to ____ ft. depth

Height Above/Below Surface ____ ft

Weight ____ lbs/ft

Drive Shoe? Yes [✓ No]

Level w/ Grade

9. SCREEN

Type PVC Diam. 2"

Slot/Gauze 0.010 Length ____

Set Between 11 ft. and 1 ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**

____ ft. and ____ ft.

Sieve Analysis Yes (Please enclose) [✓ No]

10. STATIC WATER LEVEL 2.34 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

NA ft. after ____ hrs. pumping ____ G.P.M

Pumping Test Yes (Please enclose) No

Yield ____

12. WATER QUALITY

Chemical Analysis [✓ Yes] No Bacterial Analysis Yes No

Please Enclose Lab Results See Appendix II

13. ARTIFICIAL FILTER (Gravel Pack) [✓ Yes] No

Installed from 11' ft. to 1 ft

Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? [✓ Yes] No

Neat Cement [✓] Sand Cement Concrete Other [✓] 0.5 feet Bentonite

Depth From 1 ft to 0 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION 100 Feet NW Direction

UST Type Well disinfected upon completion Yes [✓ No] Type ____ Amount ____

16. PUMP Date installed N/A not installed

Mfr. name ____ model no ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: Submersible / Jet (shallow) / Turbine / Jet (deep) / Reciprocating / Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME S+ME Inc ADDRESS 840 Low Country, Mt. Pleasant, SC 29464

NAME Henry Heschle III CERT. NO. 1049

Signed [illegible] Date 2/18/93

AUTHORIZED REPRESENTATIVE

DHEC Exp 96 (1/85) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 758-5213 | **Water Well Record**

1 LOCATION OF WELL

Chas. System Name: CNS-1346-3

Latitude: 32°51'22" Longitude: 79°57'51"

Distance And Direction from Road Intersections

100 feet South West Enterprise and Borie St.

Street address & City of Well Location

Sketch Map. (See example on back)

See figs. 1 and 4 of this report

7. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	*THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
Silty Clay fill	4	4
Grey Silty Clay	9	13
▽ at 5'		

* Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4 OWNER OF WELL Address: Charleston Naval Shipyard Environmental Protection Division Code 106.2 Charleston, SC (803) 743-5519

Engineer Address: S+ME Inc. 340 Low Country Blvd Mt. Pleasant, SC 29464 Telephone No (803) 884-0005

5 WELL DEPTH (Completed) 13 ft Date Started 1-6-93 Date Completed 1-8-93

6 ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7 USE ☐ Domestic ☐ Public Supply Permit No ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Groundwater Monitoring Well

8 CASING ☒ Threaded ☐ Welded

Diam 2" Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

2 in to 13 ft depth

in to ft depth

Height Above/Below Surface ft Weight lbs/ft Drive Shoe? ☐ Yes ☐ No

9. SCREEN Type PVC Diam 2" Slot/Gauze 0.010 Length 10'

Set Between ft. and ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET

ft. and ft.

Sieve Analysis ☐ Yes (Please enclose) ☒ No

10 STATIC WATER LEVEL 5.37 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface NA ft. after hrs. pumping G.P.M

Pumping Test ☐ Yes (Please enclose) ☐ No

Yield

12 WATER QUALITY Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No

Please Enclose Lab Results See Appendix II

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No

Installed from 13 ft. to 2 ft.

Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? ☒ Yes ☐ No

Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☒ 1 foot Bentonite

Depth From 1 ft to 0 ft.

15 NEAREST SOURCE OF POSSIBLE CONTAMINATION 600 Feet NE Direction

UST Type Well disinfected upon completion ☐ Yes Type ☐ No Amount

16. PUMP Date Installed NA not installed ☐

Mfr. name model no

H.P. volts length of drop pipe ft capacity gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME S+ME Inc Henry Hoeckle III ADDRESS 840 Low Country Mt. Pleasant, SC 29464

CERT. NO. 1049

Signed [signature] AUTHORIZED REPRESENTATIVE Date 2/18/93

DHEC Exp 96 (1/85) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 758-5213 | Water Well Record

1 TION OF WELL

Chas. System Name: CNS-1346-4

Latitude: 32° 51' 22" Longitude: 79° 57' 51"

Distance And Direction from Road Intersections
300 feet North of Enterprize and Borie St.

Street address & City of Well Location

Sketch Map: (See example on back)

See figs. 1 and 4 of this report

CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	*THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
silty clay	8	8
Grey S.H. clay	5	13
∇ at 5'		

* Indicate water bearing zones (use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL
Address: Charleston Naval Shipyard Environmental Protection Division Code 106.2
Telephone No: Charleston, SC (803) 743-5519

Engineer
Address: S+ME Inc. 340 Low Country Blvd Mt. Pleasant, SC 29464
Telephone No: (803) 884-0005

5 WELL DEPTH (Completed) 13 ft Date Started 1-6-93 Date Completed 1-8-93

6 ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7 USE
☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Groundwater Monitoring Well

8 CASING ☒ Threaded ☐ Welded
Diam. 2
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
___ in to ___ ft. depth
___ in to ___ ft. depth
Height Above/Below Surface ___ ft
Weight ___ lbs/ft
Drive Shoe? ☐ Yes ☐ No

9 SCREEN
Type PVC Diam. 2"
Slot/Gauze 0.010 Length
Set Between 13 ft. and 3 ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET
___ ft. and ___ ft
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10 STATIC WATER LEVEL
5.33 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
NA ft. after ___ hrs. pumping ___ G.P.M.
Pumping Test ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results See Appendix II

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 13 ft. to 2 ft
Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? ☒ Yes ☐ No
Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☒ 1 foot Bentonite
Depth From 2 ft to 0 ft.

15 NEAREST SOURCE OF POSSIBLE CONTAMINATION 50 Feet North Direction
UST Type Well disinfected upon completion ☐ Yes ☐ No Type Amount

16. PUMP Date installed NA ☐ not installed
Mfr. name ___ model no ___
H.P. ___ volts ___ length of drop pipe ___ ft. capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME: S+ME Inc. Henry Heschle III
ADDRESS: 340 Low Country Blvd Mt. Pleasant, SC 29464
CERT. NO. 1049
Signed ___ Date 2/16/93
AUTHORIZED REPRESENTATIVE

)HEC Exp 96 (1/85) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 758-5213 | Water Well Record

ATION OF WELL

System Name: CNS-1346-5

Chas.

Latitude: 32° 51' 22" Longitude: 79° 57' 51"

Distance And Direction from Road Intersections

100' East of Enterprise and Borie St.

Street address & City of Well Location

Sketch Map: (See example on back)

See figs. 1 and 4 of this report

2. CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	*THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
Red Silty Clay	3	3
Grey Silty Clay	10	13
▽ at 5'		
* Indicate water bearing zones (use a 2nd sheet if needed)		

REMARKS

4 OWNER OF WELL
Address: Charleston Naval Shipyard, Environmental Protection Division, Code 10602
Telephone No: Charleston, SC (803) 743-5519

Engineer
Address: S+ME Inc. 340 Low Country Blvd, Mt. Pleasant, SC 29464
Telephone No: (803) 884-0005

5 WELL DEPTH (Completed): 13 ft. Date Started: 1-6-93 Date Completed: 1-8-93

6 ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7 USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Groundwater Monitoring Well

8 CASING ☒ Threaded ☐ Welded
Diam: 4"
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
4 in to 13 ft depth
in to ft depth
Height Above/Below Surface ft
Weight lbs/ft
Drive Shoe? ☐ Yes ☒ No
Level w/ Grade

9 SCREEN
Type PVC Diam 4"
Slot/Gauze 0.010 Length
Set Between 13 ft and 3 ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET
ft and ft
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10 STATIC WATER LEVEL
4.84 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
NA ft. after hrs. pumping G.P.M
Pumping Test ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results See Appendix II

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 13 ft. to 2 ft
Effective size 0.1499 uniformity coefficient 1.6

14. WELL GROUTED? ☒ Yes ☐ No
Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☒ 1 foot Bentonite
Depth From 2 ft to 0 ft. NA

15 NEAREST SOURCE OF POSSIBLE CONTAMINATION: 0 Feet Direction
UST Type Well disinfected upon completion ☐ Yes Type ☐ No Amount

16. PUMP Date Installed NA not installed ☐
Mfr. name model no.
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME: S+ME Inc ADDRESS: 840 Low Country Mt. Pleasant, SC
Henry Heschle III
CERT. NO. 1049
Signed AUTHORIZED REPRESENTATIVE Date 2/18/93

DHEC Exp 96 (1/85) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 758-5213 | Water Well Record

1 LOCATION OF WELL

County Chas. System Name: CNS-1346-6

Latitude 32°51'22" Longitude 79°57'51"

Distance And Direction from Road Intersections
100' East of Enterprise and Borie St.

Street address & City of Well Location

Sketch Map (See example on back)

See figs. 1 and 4 of this report

2 CUTTING SAMPLES ☐ Yes ☒ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	*THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
Red Silty Clay	3	3
Grey Silty Clay	26'	29'
Marl at 29'		
▽ at 5'		

* Indicate water bearing zones (use a 2nd sheet if needed)

4 OWNER OF WELL
Address: Charleston Naval Shipyard Environmental Protection Division Code
Telephone No: Charleston, SC (803) 743-5519

Engineer
Address: SIMEI Inc. 940 Low Country Blvd Mt. Pleasant, SC 29464
Telephone No: (803) 884-0005

5 WELL DEPTH (Completed) 28 ft
Date Started 1-20-93
Date Completed 1-21-93

6 ☒ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7 USE
☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Groundwater Monitoring Well

8 Casing: ☒ Threaded ☐ Welded
Diam 6" / 2"
Type ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
6" in to 13 ft depth
2" in to 23 ft depth
Height Above/Below Surface ft
Weight lbs/ft
Drive Shoe? ☐ Yes ☒ No
Level w/ Grade

9 SCREEN
Type PVC Diam 2"
Slot/Gauge 0.010 Length
Set Between 28 ft and 23 ft
ft and ft
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (Please enclose) ☒ No

10 STATIC WATER LEVEL
5.13 ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
NA ft. after hrs. pumping G.P.M.
Pumping Test ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☒ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results See Appendix II

13. ARTIFICIAL FILTER (Gravel Pack) ☒ Yes ☐ No
Installed from 29 ft. to 22 ft
Effective size 0.499 uniformity coefficient 1.6

14. WELL GROUTED? ☒ Yes ☐ No 9 feet
Neat Cement ☒ Sand Cement ☐ Concrete ☐ Other ☒ Bentonite
Depth From 22 ft to 0 ft.

15 NEAREST SOURCE OF POSSIBLE CONTAMINATION 0 Feet NA Direction
UST Type Well disinfected upon completion ☐ Yes ☐ No Type Amount

16. PUMP Date installed NA ☐ not installed
Mfr. name model no
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION. This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED BUSINESS NAME Quality Drilling Serv. ADDRESS 6767 Peters Point Rd.
Signed R. Quinn CERT. NO. 477
AUTHORIZED REPRESENTATIVE Date 02-18-93

1 REMARKS

DHEC Exp 96 (1/85) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

APPENDIX II

ANALYTICAL RESULTS

HYDROLOGIC COLUMBIA
Sample Data Report
SC Certification No. 40101
Preliminary Report

Date : 2/12/93
Project : Navy Base
Client : S & ME Inc.
Date Collected : 2/5/93
Date Received : 2/9/93
Date Analyzed : 2/9/93
Date Reported : 2/12/93

Sample ID	Client ID	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE	5030 TPH
93-0683	MW-1	<2.5	<2.5	<2.5	<7.5	<50	<0.1
93-0684	MW-2	<2.5	<2.5	<2.5	<7.5	<50	<0.1
93-0685	MW-3	<2.5	<2.5	<2.5	<7.5	<50	<0.1
93-0686	MW-4	<2.5	<2.5	<2.5	<7.5	<50	<0.1
93-0687	MW-5	23300	36400	4140	18900	92900	23.4
93-0688	MW-6	<2.5	<2.5	<2.5	<7.5	130	<0.1
93-0689	OT	863	27.1	124	47.5	180	<0.1
93-0690	C-5&6	23000	146000	50000	183000	42900	150
93-0691	C-1,2,3,4	<6.0	27.9	6.78	48.7	<50	<0.1

BTEX + MTBE Units = ug/L (parts per billion) Water by M602
TPH Units = mg/L (parts per million) Water by M5030
BTEX + MTBE Units = ug/kg (parts per billion) Soil by M8020

Data Approved for Release:

Jay L. Clark for R.DD
Robert D. Downing
Lab Manager

PO# [illegible]

HydroLogic Inc.
800-476-0913
803-750-0613
FAX 803-750-9505
100 Ashland Park Lane, Suite E • Columbia, SC 29210

HydroLogic • Columbia, South Carolina

PAGE 1 OF 1

CHAIN OF CUSTODY RECORD

SAMPLE ANALYSIS REQUIRED

CLIENT: SME Inc. CHAS S.C. NAVY BASE

SAMPLER(S) SIGNATURE: [illegible]

PRESERVATION (CODE)

CODE: A = NONE
B = H2SO4
C = NaOH
D = HNO3
E = ______

LAB USE ONLY

SAMPLE ID (LOCATION)	DATE	TIME	WELL	SOLID	COMP	GRAB	# OF CONTAINERS	INORGANIC-SPECIFY	NUTRIENT-SPECIFY	METALS-SPECIFY	VOC-602	VOC-BTEX/MTBE	VOC-601	TPH-GC (TPH/GC Volatiles) (GC VOA)	B/N-EXTRACTABLES	ACIDS-EXTRACTABLES	T-Pb	Diss Pb	PCBs	TOTAL PHENOL	COLIFORM-SPECIFY	TOXICITY-SPECIFY	CYANIDE	PROGRAM SC		REMARKS (300 comig on MW 5 Gui to go Sub.)	LAB I.D.
MW-1	2/5		X			X	4					X		X													93-0683
MW-2			X			X	4					X		X													93-0684
MW-3			X			X	4					X		X													93-0685
MW-4			X			X	4					X		X													93-0686
MW-5			X			X	10					X	X	X			X	X								WORST CASE WELL	93-0687
MW-6			X			X	4					X		X													93-0688
OT			X			X	4					X		X													93-0689
C-5+6				X	X		1					X		X												Drum Comp	93-0690
C-1,2,3,4				X	X		1					X		X												Drum Comp	93-0691

RELINQUISHED BY: (Sig.)	DATE/TIME	RECEIVED BY: (Sig)	RELINQUISHED BY: (Sig)	DATE/TIME	RECEIVED BY: (Sig.)
[illegible]	2/5 1800	DHL Express			
RELINQUISHED BY: (Sig.)	DATE/TIME	RECEIVED BY: (Sig)	RELINQUISHED BY: (Sig)	DATE/TIME	RECEIVED BY: (Sig)

LAB RECEIPT BY: (Sig.) [illegible]

DATE/TIME 2/9/5 12:47

REMARKS: Will Send PO Monday

APPENDIX III

SLUG TEST DATA AND CALCULATIONS

SIMS
R40 LOW CONDITY S.L.C.
CHARLESTON, SOUTH CAROLINA

HORIZONTAL HYDRAULIC CONDUCTIVITY
Method of Bouwer and Rice, 1976
After H. Bouwer, 1989

PROJECT NAME: NAVY BASE UST
CITY, STATE : CHAS., S.C.
PROJECT NO. : 1134-92-0c9

WELL NUMBER : MW-1
DATE OF TEST: 1-11-93
TEST BY : MIKE BASHA

WELL/AQUIFER DATA - PARTIALLY PENETRATING WELL

Casing Diameter (in)	=	2.00
Borehole Diameter (in)	=	8.25
Depth to Top of Screen (ft)	=	1.00
Depth to Bottom of Screen (ft)	=	11.00
Depth to static Water Level (ft)	=	2.01
Depth to Lower Confining Unit (ft)	=	29.00
Assured Filter Pack Porosity (frac)	=	0.30

EQUATION PARAMETERS

Re = We'l Radius taking into account the filter pack (ft)	=	0.4
rw = Radius of the borehole (ft)	=	0.17
Le = Length of well through which water enters (ft)	=	9.99
Lw = Distance from water table to bottom of screen (ft)	=	8.99
H = Distance from water table to lower confining unit (ft)	=	26.99
A = Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	2.7
B = Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	0.4
Re = Effective radius over which headloss (y) is dissipated (ft)	=	2.47
yo = Change in head at time (t)=0, (ft)	=	1.15
yt = Change in head at time t, (ft)	=	0.56
t = Elasped time at which head change = yt,	=	0.1
Units of time as measured in the field	=	MIN

KEY EQUATIONS

$$\ln(Re/rw)=1/((1.1/\ln(Lw/rw))+(A+B*\ln((H-Lw)/rw))/(Le/rw)$$

$$Kh=(req^2*\ln(Re/rw)/2Le)(1/t)(\ln(yo/yt))$$

RESULTS

Kh = Horizontal Hydraulic Conductivity	(ft/day)	= 0.25E+02
	(cm/sec)	= 0.88E-02
	(gpd/ft^2)	= 0.19E+03

S&ME

JOB NO. 1134-92-069
SHEET NO.
DATE 2-13-93
COMPUTED BY M. Basha
CHECKED BY H. Connolly

NAME NAVUST
SUBJECT Slugtest Data

#B-1

SE1[illegible]
Environmental Logger
02/13 0[illegible]:[illegible]7

Unit# 00001 Test 2

MW-1

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.070
Scale factor	15.030
Offset	-0.010
Delay mSEC	50.000

Step 0 02/13 04:02:17

Elapsed Time	INPUT 1
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
~~[illegible]~~	~~[illegible]~~
0.0500	0.942
0.0666	0.829
0.0833	0.729
0.1000	0.667
0.1166	0.606
0.1333	0.549
0.1500	0.506
0.1666	0.457
0.1833	0.440
0.2000	0.412
0.2166	0.387
0.2333	0.367
0.2500	0.349
0.2666	0.331
0.2833	0.312
0.3000	0.307
0.3166	0.295
0.3333	0.284
0.4166	0.269
0.5000	0.270
0.5833	0.251
0.6666	0.236
0.7500	0.221
0.8333	0.227
0.9166	0.217
1.0000	0.207
1.0833	0.207
1.1666	0.195
1.2500	0.192
1.3333	0.189
~~[illegible]~~	~~[illegible]~~

S&ME

JOB NO. 1134-92-069

SHEET NO. _____

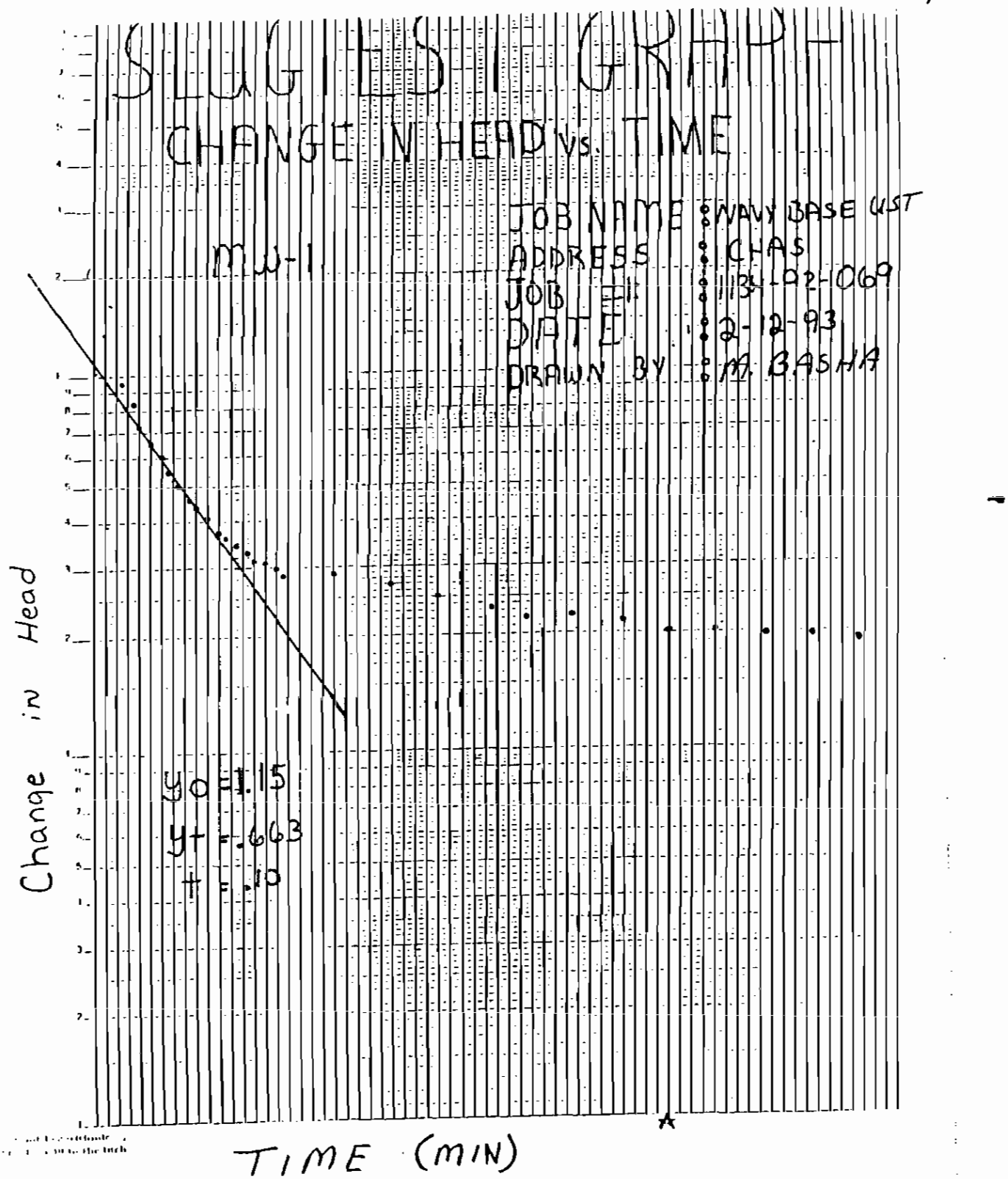
DATE 2-13-93

NAME NAVUST

SUBJECT Slug test Data

COMPUTED BY M. Basha

CHECKED BY H. Connolly

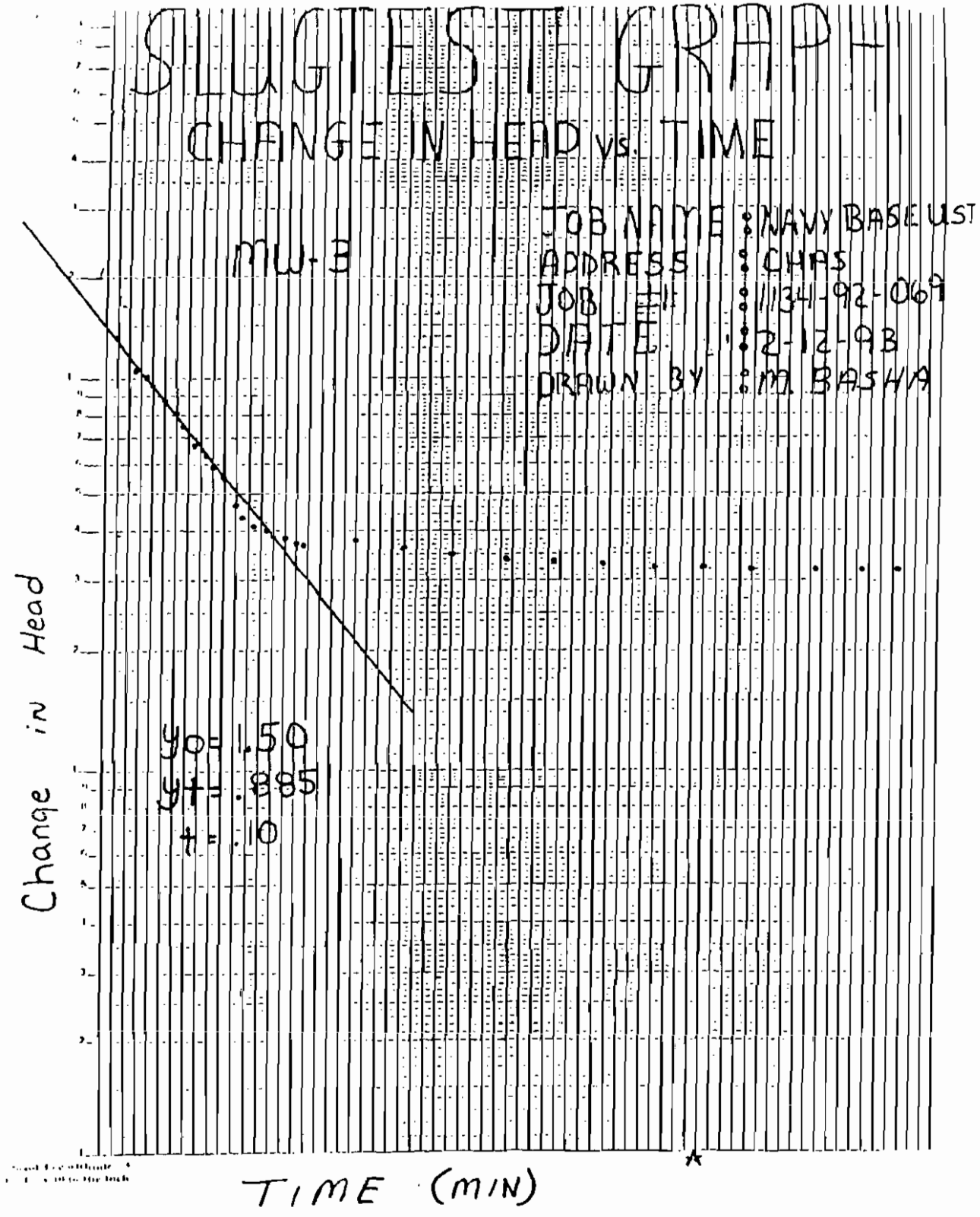


S&ME

JOB NO. 1134-92-069
SHEET NO.
DATE 2-13-93

NAME NAVUST
SUBJECT Slug test Data

COMPUTED BY M. Basha
CHECKED BY H. Connelly



S&ME

JOB NO. 1134-92-069
SHEET NO. _____
DATE 2-13-93

NAME NAVUST
SUBJECT Slug test Data

COMPUTED BY M. Basha
CHECKED BY H. Connolly

NB-3

SE10000

Environmental Logger
02/17 06:39

Unit# 00001 Test 1

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.070
Scale factor	15.020
Offset	-0.010
Delay mSEC	50.000

MW-3

Step 0 02/17 03:45:52

Elapsed Time	INPUT 1
~~0.0000~~	~~0.170~~
~~0.0033~~	~~0.568~~
~~0.0066~~	~~1.279~~
~~0.0100~~	~~0.330~~
~~0.0133~~	~~1.725~~
~~0.0166~~	~~1.296~~
~~0.0200~~	~~0.795~~
~~0.0233~~	~~1.102~~
~~0.0266~~	~~1.115~~
~~0.0300~~	~~0.376~~
~~0.0333~~	~~0.022~~
0.0500	1.112
0.0666	1.022
0.0833	0.965
0.1000	0.885
0.1166	0.809
0.1333	0.743
0.1500	0.681
0.1666	0.634
0.1833	0.591
0.2000	0.558
0.2166	0.482
0.2333	0.435
0.2500	0.416
0.2666	0.402
0.2833	0.388
0.3000	0.383
0.3166	0.373
0.3333	0.369
0.4166	0.378
0.5000	0.364
0.5833	0.350
0.6666	0.340
0.7500	0.336
0.8333	0.331
0.9166	0.326
1.0000	0.326
1.0833	0.321
1.1666	0.321
1.2500	0.321
1.3333	0.321
~~1.4166~~	~~0.317~~

SAME
840 LOW COUNTRY BLVD.
CHARLESTON, SOUTH CAROLINA

HORIZONTAL HYDRAULIC CONDUCTIVITY
Method of Bouwer and Rice, 1976
After H. Bouwer, 1989

PROJECT NAME: NAVY BASE UST
CITY, STATE : CHAS., S.C.
PROJECT NO. : 1134-92-069

WELL NUMBER : MW-7
DATE OF TEST: 3-12-93
TEST BY : MIKE BASHA

WELL/AQUIFER DATA - PARTIALLY PENETRATING WELL

Casing Diameter (in)	=	2.00
Borehole Diameter (in)	=	6.25
Depth to Top of Screen (ft)	=	2.00
Depth to Bottom of Screen (ft)	=	12.00
Depth to Static Water Level (ft)	=	5.37
Depth to Lower Confining Unit (ft)	=	29.00
Assumed Filter Pack Porosity (frac)	=	0.30

EQUATION PARAMETERS

req = Well Radius taking into account the filter pack (ft)	=	0.15
rw = Radius of the borehole (ft)	=	0.26
Le = Length of well through which water enters (ft)	=	6.63
Lw = Distance from water table to bottom of screen (ft)	=	6.63
H = Distance from water table to lower confining unit (ft)	=	23.63
A = Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	2.4
B = Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	0.4
Re = Effective radius over which headloss (v) is dissipated (ft)	=	1.93
yo = Change in head at time (t)=0, (ft)	=	1.50
yt = Change in head at time t, (ft)	=	0.89
t = Elasped time at which head change = yt,	=	0.1
Units of time as measured in the field	=	MIN

KEY EQUATIONS

$$\ln(Re/rw)=1/((1.1/\ln(Lw/rw))+(A+B*\ln((H-Lw)/rw))/(Le/rw)$$

$$Kh=(req^2*\ln(Re/rw)/2Le)(1/t)(\ln(yo/yt))$$

RESULTS

Kh = Horizontal Hydraulic Conductivity (ft/day) = 0.29E+02
(cm/sec) = 0.10E-01
(gpd/ft^2) = 0.22E+03

S&ME
840 LOW COUNTRY BLVD.
CHARLESTON, SOUTH CAROLINA

HORIZONTAL HYDRAULIC CONDUCTIVITY
Method of Bouwer and Rice, 1976
After H. Bouwer, 1989

PROJECT NAME: NAVY BASE UST
CITY, STATE : CHAS., S.C.
PROJECT NO. : 1134-92-069

WELL NUMBER : MW-4
DATE OF TEST: 2-12-93
TEST BY : MIKE BASHA

WELL/AQUIFER DATA - PARTIALLY PENETRATING WELL

Casing Diameter (in)	=	2.00
Borehole Diameter (in)	=	6.25
Depth to Top of Screen (ft)	=	2.00
Depth to Bottom of Screen (ft)	=	12.00
Depth to Static Water Level (ft)	=	5.33
Depth to Lower Confining Unit (ft)	=	29.00
Assumed Filter Pack Porosity (frac)	=	0.30

EQUATION PARAMETERS

req	= Well Radius taking into account the filter pack (ft)	=	0.16
rw	= Radius of the borehole (ft)	=	0.26
Le	= Length of well through which water enters (ft)	=	6.67
Lw	= Distance from water table to bottom of screen (ft)	=	6.67
H	= Distance from water table to lower confining unit (ft)	=	23.67
A	= Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	2.4
B	= Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	0.40
Re	= Effective radius over which headloss (y) is dissipated (ft)	=	1.94
yo	= Change in head at time (t)=0, (ft)	=	1.20
yt	= Change in head at time t, (ft)	=	0.60
t	= Elasped time at which head change = yt,	=	0.2
	Units of time as measured in the field	=	MIN

KEY EQUATIONS

$$\ln(Re/rw)=1/((1.1/\ln(Lw/rw))+(A+B*\ln((H-Lw)/rw))/(Le/rw)$$

$$Kh=(req^2*\ln(Re/rw)/2Le)(1/t)(\ln(yo/yt))$$

RESULTS

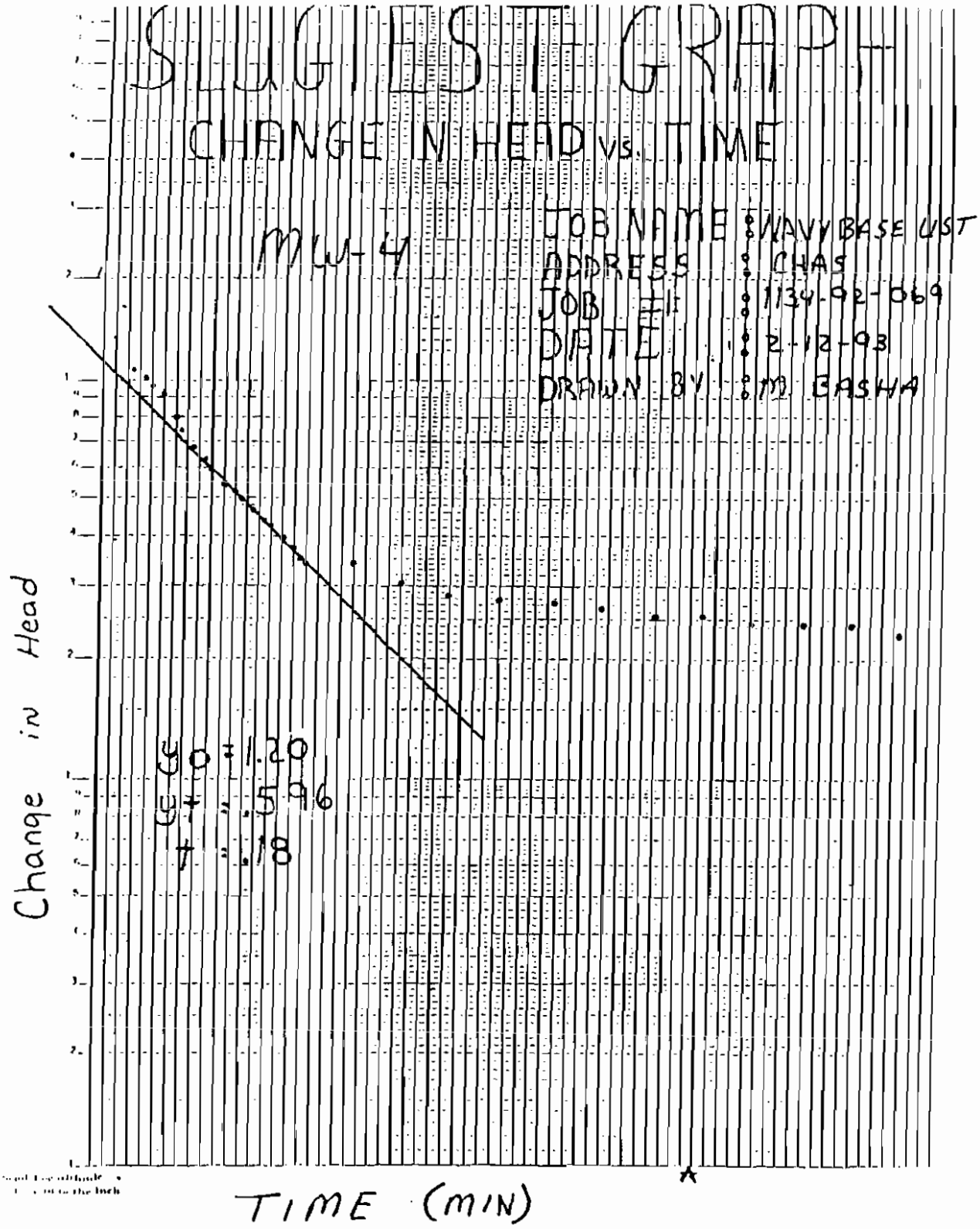
Kh = Horizontal Hydraulic Conductivity	(ft/day) =	0.21E+02
	(cm/sec) =	0.75E-02
	(gpd/ft^2) =	0.16E+03

S&ME

JOB NO. 1134-92-069
SHEET NO. _____
DATE 2-13-93

AME NAVUST
SUBJECT Slug test Data

COMPUTED BY M. Basha
CHECKED BY H. Connolly



S&ME

JOB NO. 1134-92-069
SHEET NO. _____
DATE 2-13-93

AME NAVUST _____ COMPUTED BY M. Basha
SUBJECT Slug test Data CHECKED BY H. Connelly

NB-4

SE1000C
Environmental Logger
02/13 06:40

Unit# 00001 Test 6

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.070
Scale Factor	15.030
Offset	-0.010
Delay mSEC	50.000

MW-4

Step 0 02/13 03:30:55

Elapsed Time	INPUT 1
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
0.0500	1.150
0.0666	1.027
0.0833	0.979
0.1000	0.908
0.1166	0.800
0.1333	0.743
0.1500	0.686
0.1666	0.639
0.1833	0.594
0.2000	0.553
0.2166	0.530
0.2333	0.497
0.2500	0.468
0.2666	0.440
0.2833	0.416
0.3000	0.397
0.3166	0.374
0.3333	0.350
0.4166	0.345
0.5000	0.307
0.5833	0.288
0.6666	0.279
0.7500	0.274
0.8333	0.265
0.9166	0.255
1.0000	0.255
1.0833	0.246
1.1666	0.241
1.2500	0.241
1.3333	0.231

B&ME
840 LOW COUNTRY BLVD.
CHARLESTON, SOUTH CAROLINA

HORIZONTAL HYDRAULIC CONDUCTIVITY
Method of Bouwer and Rice, 1976
After H. Bouwer, 1989

PROJECT NAME: NAVY BASE UST
CITY, STATE : CHAS., S.C.
PROJECT NO. : 1134-92-069

WELL NUMBER : MW-6
DATE OF TEST: 2-12-93
TEST BY : MIKE BASHA

WELL/AQUIFER DATA - PARTIALLY PENETRATING WELL

Casing Diameter (in)	=	2.00
Borehole Diameter (in)	=	6.25
Depth to Top of Screen (ft)	=	23.00
Depth to Bottom of Screen (ft)	=	28.00
Depth to Static Water Level (ft)	=	5.18
Depth to Lower Confining Unit (ft)	=	29.00
Assumed Filter Pack Porosity (frac)	=	0.30

EQUATION PARAMETERS

req = Well Radius taking into account the filter pack (ft)	=	0.08
rw = Radius of the borehole (ft)	=	0.26
Le = Length of well through which water enters (ft)	=	5.00
Lw = Distance from water table to bottom of screen (ft)	=	23.82
H = Distance from water table to lower confining unit (ft)	=	23.82
A = Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	2.7
B = Coefficient of Le/rw from Figure 2, (from H. Bouwer)	=	0.39
Re = Effective radius over which residual (y) is dissipated (ft)	=	3.50
yo = Change in head at time (t)=0, (ft)	=	1.33
yt = Change in head at time t, (ft)	=	1.32
t = Elasped time at which head change = yt,	=	0.1
Units of time as measured in the field	=	min

KEY EQUATIONS

$$\ln(Re/rw)=1/((1.1/\ln(Lw/rw)+(A+B*\ln((H-Lw)/rw))/(Le/rw)$$

$$Kh=(req^2*\ln(Re/rw)/2Le)(1/t)(\ln(yo/yt))$$

RESULTS

Kh = Horizontal Hydraulic Conductivity	(ft/day)	= 0.63E+00
	(cm/sec)	= 0.22E-03
	(gpd/ft^2)	= 0.47E+01

S&ME

JOB NO. 1134-92-069

SHEET NO. _____

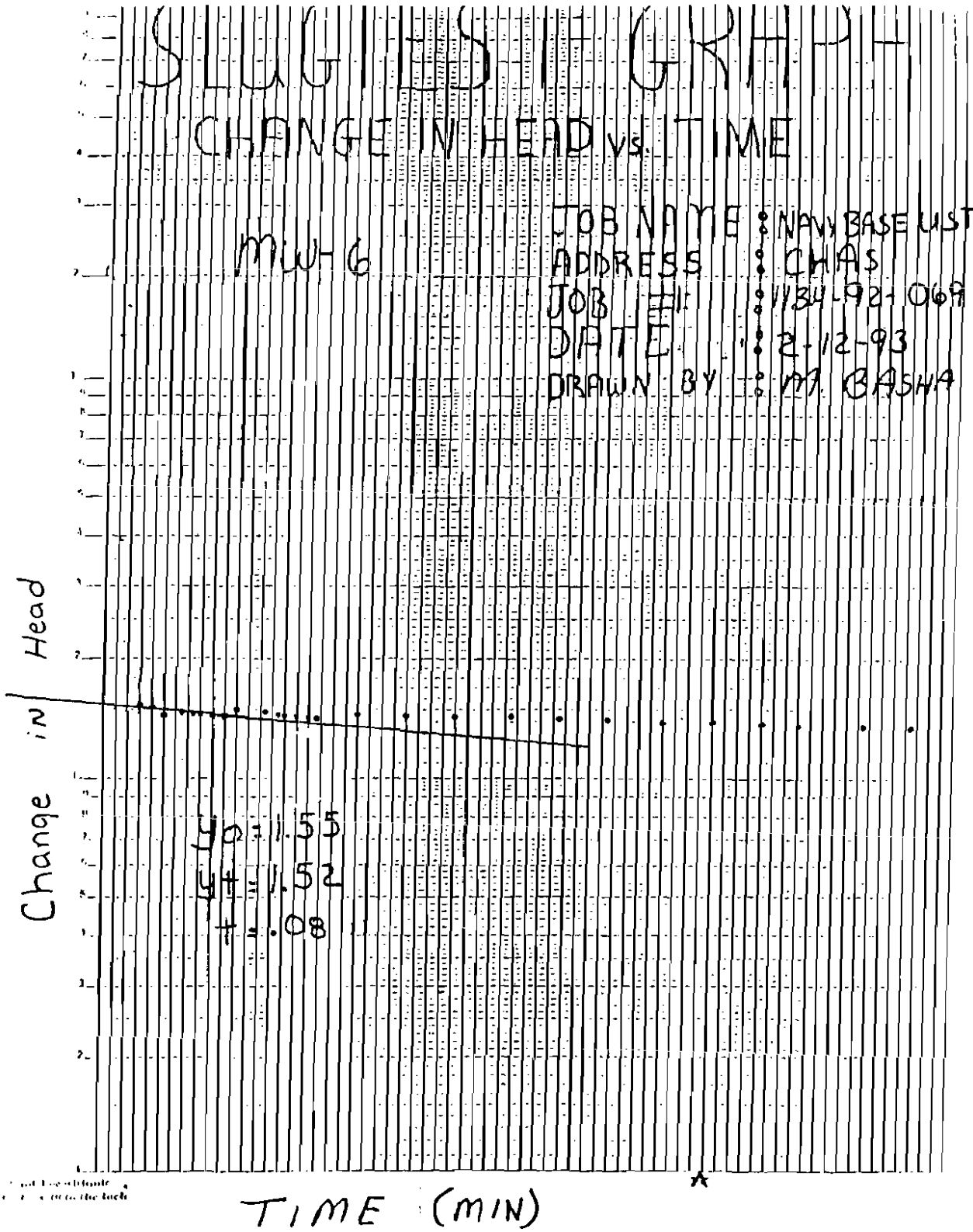
DATE 2-13-93

AME NAVUST

SUBJECT Slug test Data

COMPUTED BY M. Basha

CHECKED BY H. Connolly



S&ME

JOB NO. 1134-92-069
SHEET NO.
DATE 2-13-93
NAME NAVUST
SUBJECT Slug test Data
COMPUTED BY M. Basha
CHECKED BY H. Connelly

SE[illegible]
Environmental Logger
02-13 08:35

Unit# 00001 Test 4

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.070
Scale factor	15.030
Offset	-0.010
Delay mSEC	50.000

NB-6

Step 0. 02-13 04:27:27

Elapsed Time	INPUT 1
~~0.0000~~	~~0.341~~
~~0.0033~~	~~1.065~~
~~0.0066~~	~~1.393~~
~~0.0100~~	~~1.317~~
~~0.0133~~	~~1.[illegible]~~
~~0.0166~~	~~1.[illegible]~~
~~0.0200~~	~~1.[illegible]~~
~~0.0233~~	~~1.[illegible]~~
~~0.0266~~	~~1.[illegible]~~
~~0.0300~~	~~1.[illegible]~~
~~0.0333~~	~~1.[illegible]~~
~~0.0366~~	~~1.[illegible]~~
0.0666	1.579
0.0833	1.[illegible]
0.1000	1.472
0.1166	1.510
0.1333	1.496
0.1500	1.482
0.1666	1.482
0.1833	1.477
0.2000	1.468
0.2166	1.501
0.2333	1.865
0.2500	1.491
0.2666	1.468
0.2833	1.[illegible]
0.3000	1.458
0.3166	1.457
0.3333	1.453
0.4166	1.472
0.5000	1.403
0.5833	1.449
0.6666	1.434
0.7500	1.42[illegible]
0.8333	1.411
0.9166	1.397
1.0000	1.397
1.0833	1.387
1.1666	1.373
1.2500	1.368
1.3333	1.363
~~1.4166~~	~~1.349~~
~~1.5000~~	~~1.346~~

S&ME

JOB NO. 92-069
SHEET NO. 1 of 2
DATE 2/13/93

NAME NAV.UST
ECT Hydro Assesment, Bld. 1346

COMPUTED BY Hugh Connolly
CHECKED BY

Calculations

1.) Average Slug test Results (K)

CNS-1346-1	25 ft/day
CNS-1346-3	29 ft/day
CNS-1346-4	21 ft/day
	3
AVG. K	25 ft/day

* Data from deep well/CNS-1346-6 NOT USED.

2.) Horizontal Gradient/Linear Flow Velocity

A. Horizontal Gradient

$\frac{\Delta h}{\Delta L}$ Where; Δh = Change in water elevation
ΔL = Change in horizontal distance across the site

$\frac{\Delta h}{\Delta L} = \frac{3'}{205'} = 0.02 \text{ ft/ft}$

B. Linear Flow Velocity

$V = \frac{K}{N}\left(\frac{\Delta h}{\Delta L}\right)$ Where: V = horizontal/linear flow velocity

K = AVG. K * Calculation 1.

N = Assumed effective porosity of 40%.

$\frac{\Delta h}{\Delta L}$ = Horizontal Gradient

- Next page -

S&ME

JOB NO. 92-069
SHEET NO. 2
DATE 2/13/93

NAME NAV UST
SUBJECT Hydrogeologic Assessment
COMPUTED BY Hugh Connolly
CHECKED BY

Calculations continued

2.B Linear flow Velocity

$$V = \frac{25\ ft/day}{.4}\ (0.02\ ft/ft)$$

$$V = 1.7\ ft/day$$

or x365

$$V = 608\ ft/yr$$

3. Vertical Gradient Calculations

	Screen Depth	Y
Dat. i Shallow well CNS-1346-5	12'	94.73'
Deep well CNS-1346-6	28'	94.30'

$$\frac{\Delta h\ ft}{\Delta L\ ft} = \frac{94.73' - 94.30'}{12' - 28'} = \frac{0.43}{-16} = (-)0.027\ ft/ft$$

Vertical Gradient = (-)0.027 ft/ft

* Elevation higher in shallow well therefore recharge area.

S&ME

April 20, 1992

Environmental Protection Division
Charleston Naval Shipyard
Charleston Naval Base
Charleston, South Carolina 29408-6100

Attention: Mr. Sneed

Subject: Groundwater Monitoring Well Installation Request
Navy Base Exchange Service Station
Charleston Naval Base
Charleston, South Carolina
S&ME, Inc. Job #1134-92-079

Dear Mr. Sneed:

S&ME, Inc. (S&ME) formerly Westinghouse is pleased to submit the enclosed groundwater monitoring well request to the South Carolina Department of Health and Environmental Control (SCDHEC) for your review and approval. Please review the request and contact us with any changes or corrections you may wish to have made at 884-0005.

Sincerely,

S&ME, INC.

Hugh Connolly
Project Hydrogeologist

John Albrecht, P.E.
Senior Environmental Engineer

S&ME, Inc. 840 Low Country Boulevard, Mt. Pleasant, South Carolina 29464, (803) 884-0005, Fax (803) 881-6149

S&ME

April 17, 1992

South Carolina Department of Health
and Environment Control
2600 Bull Street
Columbia, South Carolina 29201

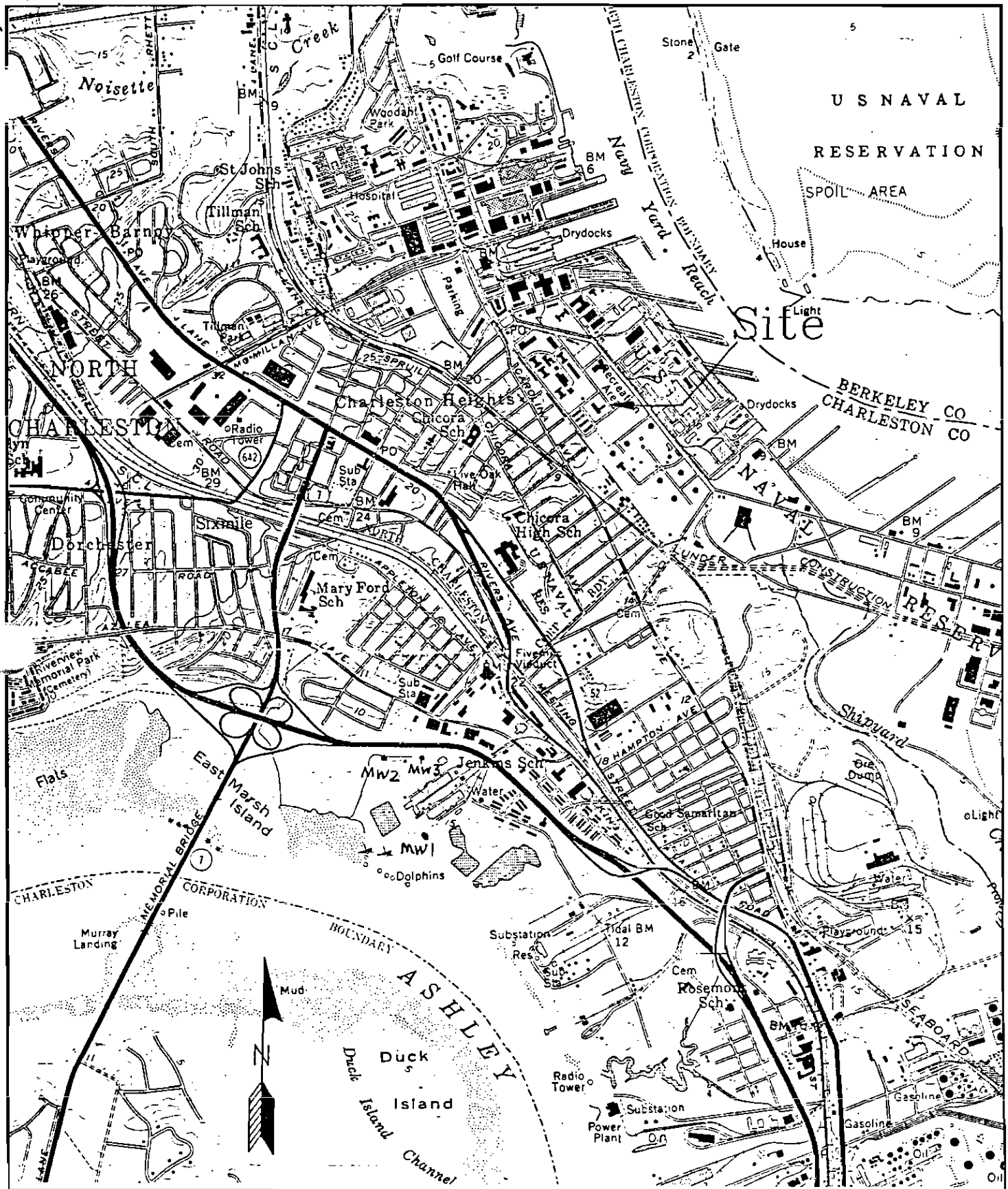
Attention: Mr. Scott McInnis

Subject: Groundwater Monitoring Well Installation
Building #1346, Navy Exchange Service Station
GWPD Site ID: A-10-AA-14067
S&ME, Inc. Job #1134-92-079

Dear Mr. McInnis:

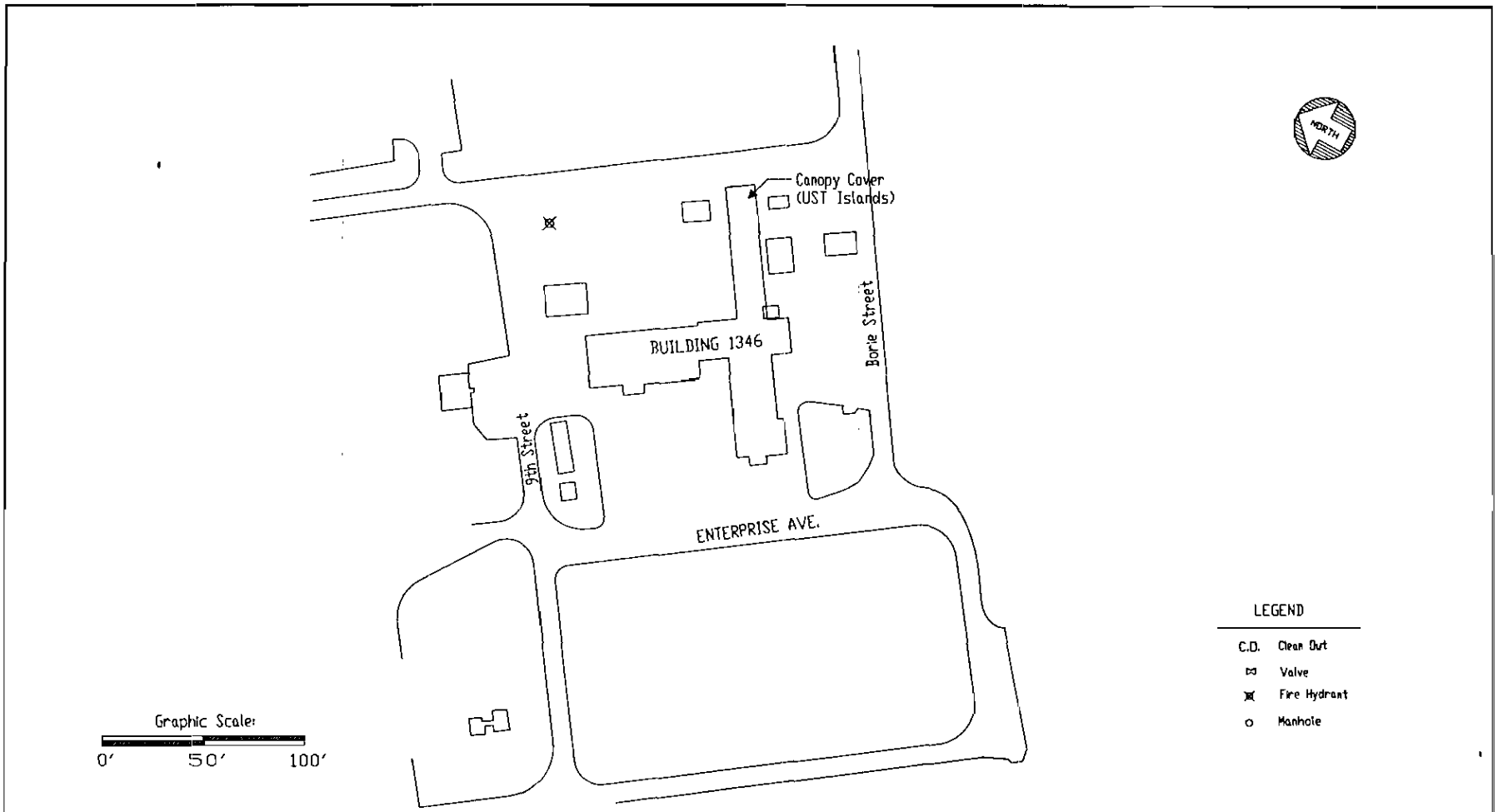
S&ME, Inc. (S&ME) requests permission to construct six groundwater monitoring wells at Building #1346, Navy Exchange Service Station on the Charleston Navy Base in Charleston, South Carolina. A site location plan is presented as Figure 1 and a site plan is provided as Figure 2. The wells are being installed for the purposes of monitoring groundwater quality and samples from these wells will be analyzed for various petroleum related constituents as outlined in our work plan dated August 7, 1992 for the site. In response to this work plan you requested in your correspondence dated January 28, 1992, that the results of the soil vapor survey be submitted with a well request to install the groundwater monitoring wells proposed in the previously referenced work plan.

Our original work plan proposed to conduct the soil vapor survey by driving a 3/8" carbon steel rod approximately 3.5 feet below grade within a specific grid location established on 50 feet centers. However, due to the dense clays of high natural organic and moisture content making up most of the site, this method proved ineffective, resulting in erroneous readings from the Photo Ionization Detector (PID). As a result, hand auger borings were performed in each grid location. Soil samples were collected at two foot intervals down to the soil/groundwater interface at a depth of six feet below grade. These samples were then bagged and a headspace analysis performed utilizing a flame ionizing organic vapor analyzer (OVA). Due to the high levels of natural organics encountered at the site, the OVA was



SCALE: 1 : 24000	DRAWN BY: NA	S&ME Environmental Services · Engineering · Testing Charleston Branch 640 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005	TITLE: Site Location Plan Hydrogeologic Assessment Building 1346 Charleston Naval Base, S.C.	FIGURE: 1
DATE: 4-1-92	CHECKED BY:			1 OF 1
JOB NO: 113492069	APPROVED BY:			

C:\ocad\blocks\a-sheet(Pe=1)



SCALE: 1" = 50'	DRAWN BY: WJM	S&ME Charleston Branch 840 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005 ENVIRONMENTAL SERVICES · ENGINEERING · TESTING	TITLE: Site Plan Hydrogeologic Assessment Building 1346 Charleston Naval Base Charleston, South Carolina
DATE: 3-13-92	CHECKED BY:		FIGURE: 2
JOB NO: 113492069	APPROVED BY:		SHEET 1 OF 1

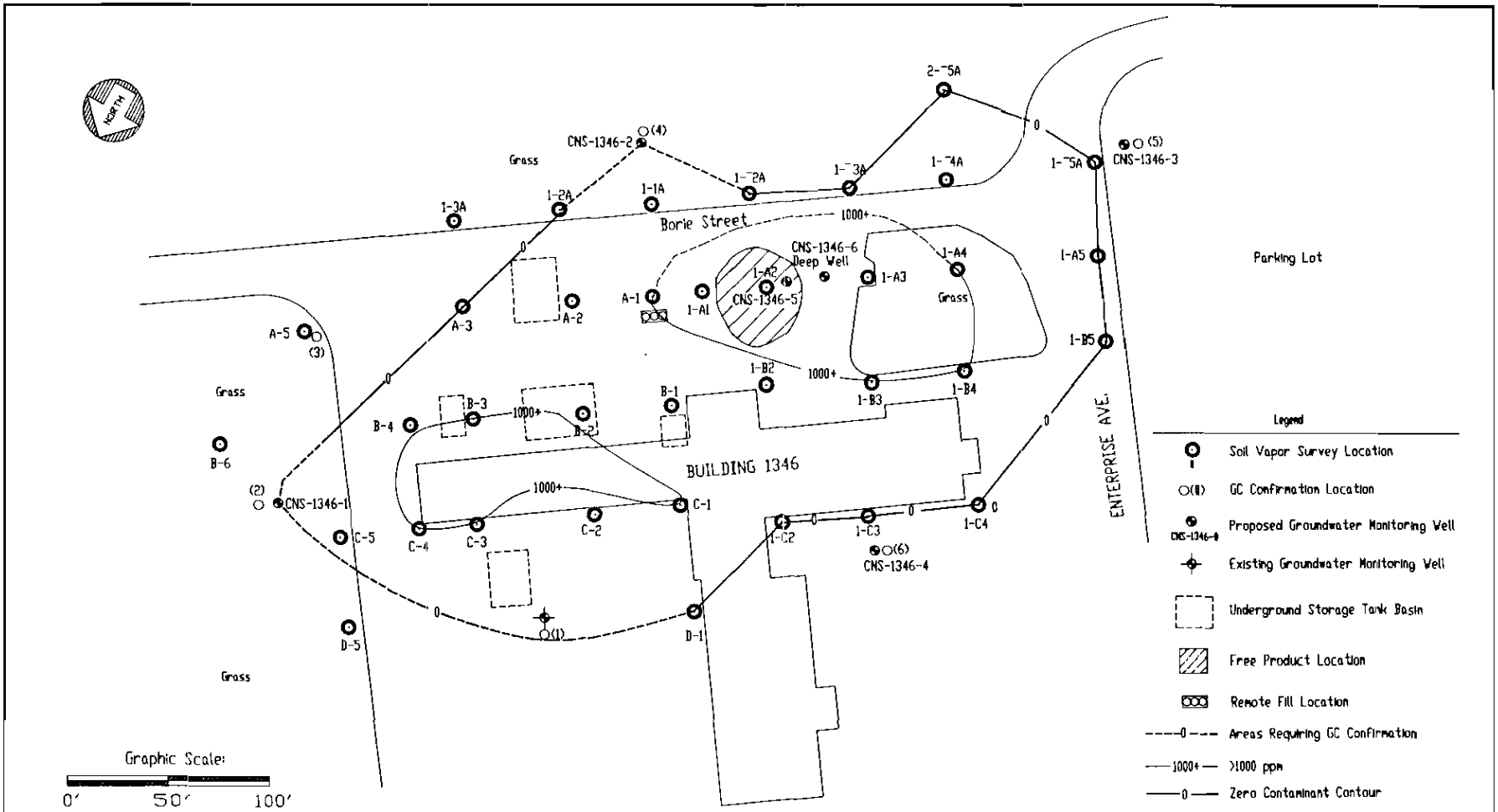
fitted with a charcoal filter to aid in screening out the natural organics. The charcoal filter would screen out the petroleum hydrocarbons (low level) and allow the OVA to read only the methane concentrations (natural organics). The methane readings were then subtracted from the total organic concentrations (headspace reading without charcoal filter) yielding a representative petroleum hydrocarbon concentration.

Although the charcoal filtration technique utilized in conjunction with the OVA aided in determining the contaminant levels for the soil samples collected, S&ME felt that some of the natural organics were being detected, hindering the determination of actual contaminant levels. The charcoal filtration technique eliminated or at least reduced the methane resulting from the natural organics, however, hydrogen sulfide will also register on the OVA. As a result several locations (i.e. well locations) were also sampled and subjected to analysis by our portable gas chromatograph for benzene, toluene and xylene concentrations. The results of the vapor survey, showing a 1000+ part per million and a zero contaminant contour are as shown on Figure 3.

As indicated by the soils encountered during the survey, those soils situated on the northeast half of the site (tank basins and pump island locations) consist of dense black-grey clays containing organic debris (twigs, leaves, etc.) down to the soil/groundwater interface encountered at an approximate depth of 6 feet below grade. Going from east to west across the site at the approximate area of grid location A-1, the organic clays grade into less dense red silty clays. Interference from natural organics was not encountered west of this area indicating a separate depositional environment as compared to those soils encountered on the opposite side of the site.

As defined by the soil vapor survey, two main areas of contamination were detected at the site yielding OVA readings greater that 1,000 ppm. One area appears to be associated with the UST basins and pump islands located on the eastern half of the site. Although this area of the site is characterized by the naturally occurring organics, samples collected in the 1,000+ ppm area possessed distinct petroleum hydrocarbon (gasoline) odors.

Due to the natural organics occurring at this portion of the site, the zero contour was established based upon OVA readings, physical observations (odor) and confirmation using our portable gas chromatograph. Background soil samples were collected from a grassed



SCALE: 1" = 50'	DRAWN BY: WJM	S&ME ENVIRONMENTAL SERVICES · ENGINEERING · TESTING	TITLE: Soil Vapor Survey Plan Hydrogeologic Assessment Building 1346 Charleston Naval Base Charleston, South Carolina
DATE: 4-15-92	CHECKED BY:	Charleston Branch 840 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005	FIGURE: 3
JOB NO: 113492069	APPROVED BY:		SHEET 1 OF 1

field adjacent to the site to the east. Two samples were collected, along "B" row at 100 and 200 feet east of Building 1346. Similar OVA readings were obtained from soil samples collected at the soil groundwater interface (i.e. location B-6 at a level of 150 ppm). Similar levels were obtained from sample location A-5 (170 ppm). Location A-5 was resampled and analyzed by portable GC and no BTX constituents were detected confirming the 170 ppm detected by OVA was natural organic concentrations. As a result, soil samples were collected along the zero contaminant contour in this area of the site for GC confirmation. The zero contour is represented by a dashed line in these areas. The soil samples subjected to GC analysis are denoted on Figure 3 by the identifying symbol in the legend followed by a number in parenthesis.

The second 1,000+ ppm area as identified by the soil vapor survey occurs on the opposite side of the site relative to the UST basins and pump islands. Also within this area an isolated pocket of free product (gasoline) was identified. The free product was identified in sample location 1 - A2. Due to the observation being made through an open borehole, S&ME was unable to make an accurate gauge as to the thickness of the product; however, product thickness greater than 10 inches was observed. The product was not present in the adjacent sample locations indicating the product is only located within 50 feet of location 1-A2. The sample locations westward past the free product location were significantly contaminated yielding OVA readings greater than 1,000 ppm (locations 1-B3, 1-B1, 1-A3 and 1-A4). Beyond these locations to the north and west, no contamination was detected by the OVA headspace analysis. Similar readings were obtained from location 1 - -2A and 1 - -3A, however; significant OVA readings as well as odors were noted in sample number 1 - -4A. As a result sample 2 - -5A was collected. No OVA readings or odors were noted within this sample.

To ensure proper well placement defining the horizontal limits of the contaminant plume and to confirm zero line locations at the northeast area of the site, S&ME collected soil samples for analysis by our portable GC. A total of six samples were collected. The sample locations are shown on Figure 3 and, as indicated earlier, are denoted by the symbol identified in the legend followed by a number in parentheses. Sample number (1) was collected adjacent to an existing groundwater monitoring well associated with the new tank basin recently constructed at the site. A minor level of benzene was detected in this sample at a level of 1.6 ppb. As a result, S&ME plans to incorporate the existing well into the assessment at the site. Sample number (2) was collected from proposed well location (CNS-

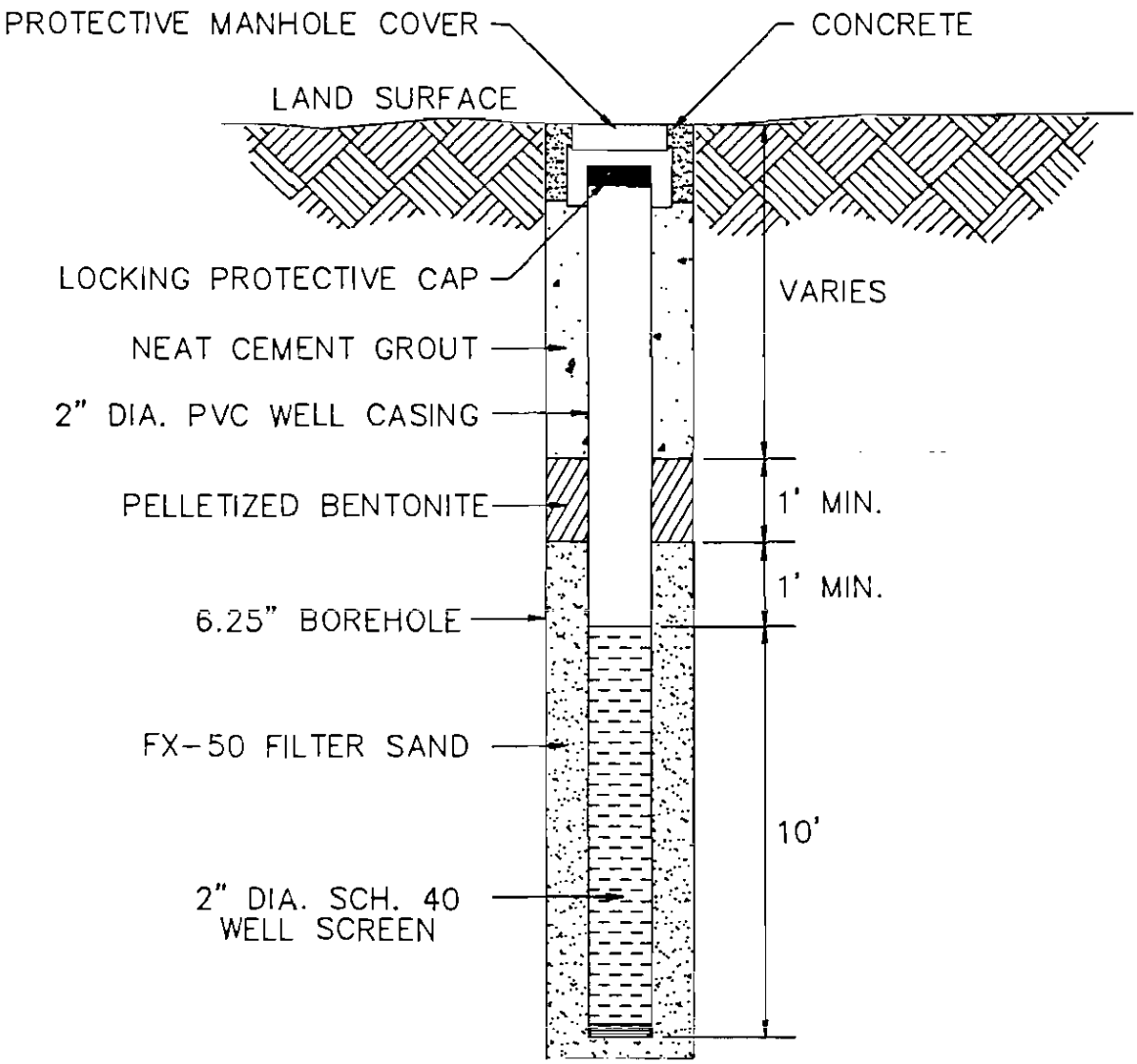
1346-1) to define the limits of contamination in this area. Only 5 ppb Toluene was detected in the sample. Sample number (3) was collected adjacent vapor survey location A-5 for comparison of OVA to GC results as explained earlier. Sample (4) was collected from proposed well location CNS-1346-2 and for confirmation of the zero contamination contour. Sample number (5) was collected from proposed well location CNS-1346-3. Sample number (6) was collected from proposed well location CNS-1346-4. Table 1 lists the recorded OVA readings resulting from the soil vapor survey and the print out for the GC analyses performed are attached.

In addition to the four shallow well locations (CNS-1346-1-4) previously discussed to confirm the horizontal extent of contamination at the site, two additional wells will be installed at the site. Well number CNS-1346-5 will be a 4-inch shallow well installed within the free product located by the soil vapor survey. This well will serve as a recovery port for the free product which should be initiated immediately after installation. This well will also serve for future worst case well analysis. Well number CNS-1346-6 will be a double cased telescoping well installed adjacent to well number CNS-1346-5 to monitor for the presence of contamination in the deeper portions of the aquifer. Measurements will also be taken from this well so that the vertical gradient for the site can be determined.

The shallow wells at the Building #1346 site will be installed as follows:

The shallow wells will be constructed by augering a 6-inch diameter hollow stem auger into the subsurface to a depth of approximately 5-feet below the seasonal high groundwater table. The boreholes will be converted to monitoring wells by the installation of a 2-inch diameter, Schedule 40 PVC casings and screens. The screen length in each well will be 10-feet and will have factory number 10 slot size (0.010 inches). A clean coarse washed filter sand (FX-50) will be installed by tremie to a depth of approximately 1.5-feet above the top of the screens. A bentonite pellet seal, one foot thick, will be installed above the filter sand. The remaining annulus of the wells will then be filled with a neat cement grout. The tops of the wells will be finished below grade in a protective vault set in a 2-foot square by 6-inch thick concrete pad and will be equipped with locking caps. Figure 4 presents a typical well construction diagram for the shallow wells.

The 4-inch diameter well will be installed in similar fashion; however due to the size of the 4-inch PVC casing and screen, a 10.25 diameter hollow stem auger will be utilized for the



TYPICAL SHALLOW MONITOR-WELL-CONSTRUCTION DETAILS
(BELOW-GRADE COMPLETION)

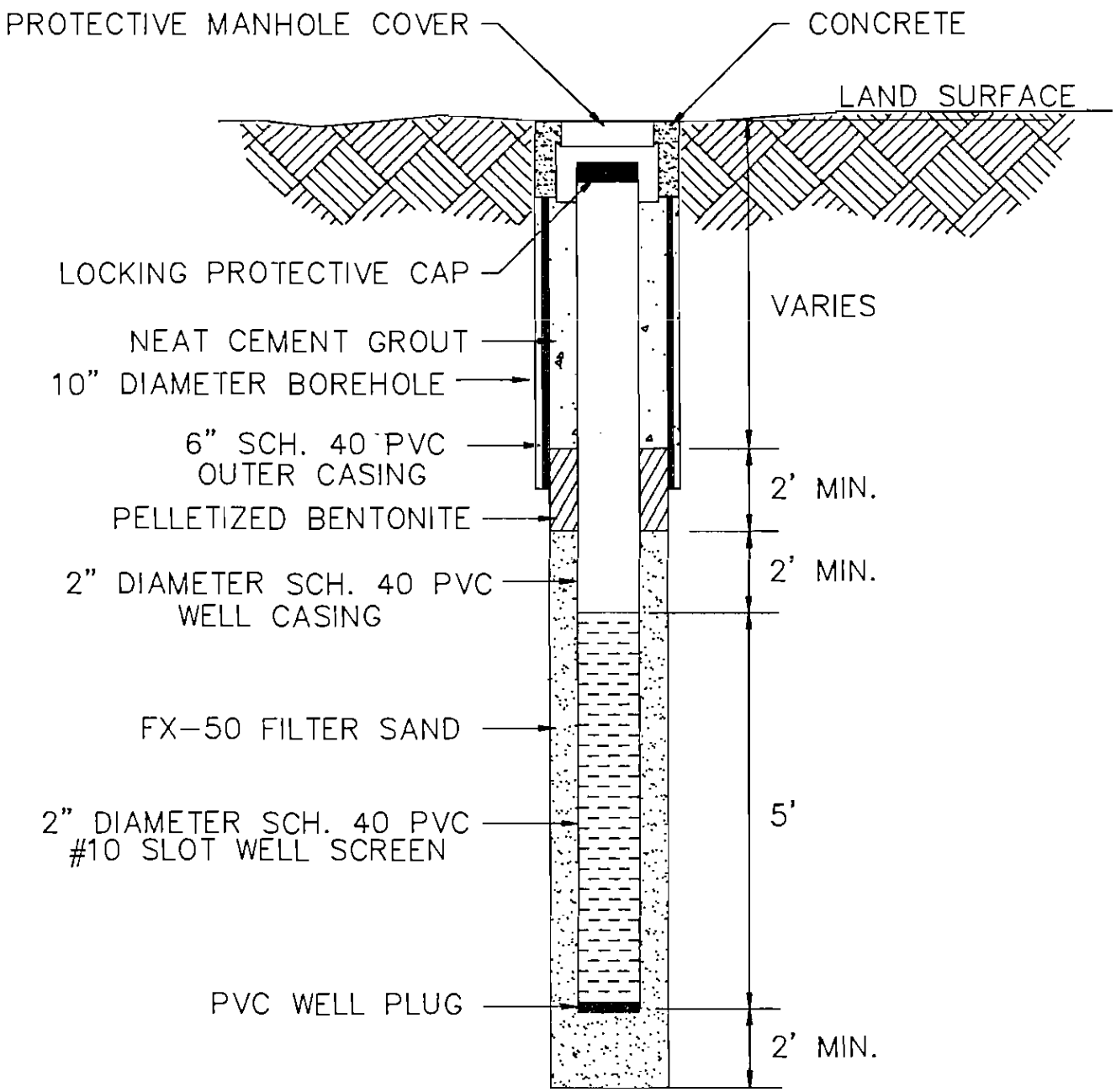
SCALE: No Scale	DRAWN BY: WJM	S&ME ENVIRONMENTAL SERVICES · ENGINEERING · TESTING	TITLE: Shallow Well Construction Diagram Hydrogeologic Assessment Building 1346 Charleston Naval Base, S.C.	FIGURE: 4
DATE: 4-15-92	CHECKED BY: HLC			
JOB NO: 113492069	APPROVED BY:			1 OF 1

installation. Also, the overall depth of the well will be adjusted so the screen is properly placed allowing the free product to be bracketed within the screened portion of the well.

To minimize the potential for the introduction of petroleum related contaminants from the upper portion of the shallow aquifer. The deep well will be installed in a telescoping manner. Initially a 10-inch diameter auger hole will be advanced to approximately 25 feet below land surface. The auger hole will be grouted up completely and the auger removed. A 6-inch diameter PVC casing will then be set in the grout to the approximate depth of the top of the screen. At least twenty-four hours later, the 6-inch casing will be bored with a 5 and 7/8-inch drag bit by mud rotary to approximately 32-feet below the land surface (Depth to Marl). The well will be set by placing 2-feet of sand pack at the bottom of the well and then lowering 5-feet of #10 slotted (0.010 inches) PVC well screen and 25-feet of PVC riser. The screen and riser will then have FX-50 sand tremied in around it from 30 to approximately 23-feet below land surface. A bentonite seal will then be placed above the sand to one foot below the surface. The remaining annulus of the well will be filled with neat cement with a water tight manhole cover. A construction diagram of a deep well is provided in Figure 5. Prior to and in between each well installation, the drilling equipment will be steam cleaned and scrubbed with a chemically neutral surfactant and rinsed with deionizing water.

The drill cuttings resulting from the well installation, will be drummed and remain on site until analytical results are returned and disposal can be coordinated. As the wells are developed, the development water will be treated using our portable carbon adsorption system for treating contaminated wastewater. The system is manufactured by Continental Environmental Systems and is capable of treating contaminated wastewater to below detectable limits. After treatment the wastewater will be administered to the parking lot of the study site and allowed to volatilize. The development water resulting from well #CNS-1346-5 (free product location) will be placed into a 55 gallon drum and remain on site until being collected by an approved recycling organization.

After development, the wells will be sampled and analyzed for petroleum related constituents as outlined in our hydrogeologic assessment work plan for the site dated August 7, 1991. The well elevations and locations will be surveyed and plotted on the site plan for the site. This information will then be presented in our final report.



TYPICAL DEEP-WELL-CONSTRUCTION DETAILS
(BELOW-GRADE COMPLETION)

CALE: No Scale	DRAWN BY: WJM	S&ME ENVIRONMENTAL SERVICES • ENGINEERING • TESTING Charleston Branch 840 Low Country Blvd. Mt Pleasant, South Carolina 29464 (803) 884-0005	TITLE: Deep Well Construction Diagram Hydrogeologic Assessment Building 1346 Charleston Naval Base, S.C.	FIGURE: 5
DATE: 4-2-92	CHECKED BY: HOC			
JOB NO: 113492069	APPROVED BY:			1 OF 1

C:\acad\blocks\Deepwell(Pen1)

S&ME appreciates your consideration and cooperation while working with you on this project and looks forward to your response. Should you have any questions, please contact Hugh Connolly at 884-0005.

Sincerely,

S&ME, INC.

Hugh Connolly
Project Hydrogeologist

John Albrecht, P.E.
Senior Environmental Engineer

TABLE 1

ORGANIC VAPOR CONCENTRATIONS
SOIL VAPOR SURVEY
BUILDING 1346, CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

LOCATION			LOCATION		
DEPTH (FT)	OVA READING (PPM)	REMARKS	DEPTH (FT)	OVA READING (PPM)	REMARKS
A-1			A-2		
0-2	120	STRONG ODOR	0-2	2.8	ODOR
2-4	440	STRONG ODOR	2-4	105	ODOR
4-6	1000 +	STRONG ODOR	4-6	460	ODOR
A-3			A-5		
0-2	20	NO ODOR	0-2	0	NO ODOR
2-4	19	NO ODOR	2-4	10	NO ODOR
4-6	5.2	NO ODOR	4-6	170	NO ODOR
1-A1 (25' location)			1-A2		
0-2	1000 +	STRONG ODOR	0-2	1000 +	STRONG ODOR
2-4	1000 +	STRONG ODOR	2-4	1000 +	STRONG ODOR
4-6	1000 +	STRONG ODOR	4-6	1000 +	STRONG ODOR
			* FREE PRODUCT ENCOUNTERED		
1-A3			1-A4		
0-2	1000 +	STRONG ODOR	0-2	6	NO ODOR
2-4	1000 +	STRONG ODOR	2-4	14	NO ODOR
4-6	1000 +	STRONG ODOR	4-6	1000 +	STRONG ODOR

TABLE 1 (CONT'D)

ORGANIC VAPOR CONCENTRATIONS
SOIL VAPOR SURVEY
BUILDING 1346, CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

LOCATION			LOCATION		
DEPTH (FT)	OVA READING (PPM)	REMARKS	DEPTH (FT)	OVA READING (PPM)	REMARKS
1-A5			B-1		
0-2	0	NO ODOR	0-2	28	ODOR
2-4	0	NO ODOR	2-4	330	ODOR
4-6	0	NO ODOR	4-6	380	STRONG ODOR
B-2			B-3		
0-2	3.2	ODOR	0-2	2.8	ODOR
2-4	50	ODOR	2-4	22	ODOR
4-6	1000 +	STRONG ODOR	4-6	1000 +	STRONG ODOR
B-4 (25' location)			B-6		
0-2	1000 +	STRONG ODOR	0-2	2	NO ODOR
2-4	1000 +	STRONG ODOR	2-4	20	NO ODOR
4-6	1000 +	STRONG ODOR	4-6	150	NO ODOR
1-B4			1-B5		
0-2	10	NO ODOR	0-2	3	NO ODOR
2-4	100	ODOR	2-4	8	NO ODOR
4-6	1000	ODOR	4-6	9	NO ODOR

TABLE 1 (CONT'D)

ORGANIC VAPOR CONCENTRATIONS
SOIL VAPOR SURVEY
BUILDING 1346, CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

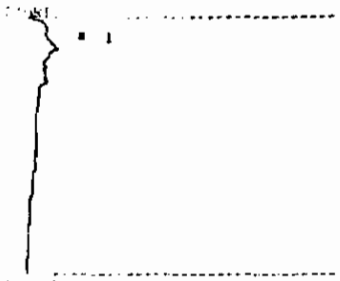
LOCATION			LOCATION		
DEPTH (FT)	OVA READING (PPM)	REMARKS	DEPTH (FT)	OVA READING (PPM)	REMARKS
C-1			C-2		
0-2	400	STRONG ODOR	0-2	10	NO ODOR
2-4	1000 +	STRONG ODOR	2-4	26	ODOR
4-6	1000 +	STRONG ODOR	4-6	70	ODOR
C-3			C-4 (25' location)		
0-2	75	ODOR	0-2	1000 +	STRONG ODOR
2-4	95	ODOR	2-4	1000 +	STRONG ODOR
4-6	1000 +	STRONG ODOR	4-6	1000 +	STRONG ODOR
C-5			1-C2		
0-2	40	NO ODOR	0-2	0	NO ODOR
2-4	73	NO ODOR	2-4	0	NO ODOR
4-6	150	NO ODOR	4-6	0	NO ODOR
1-C3			1-C4		
0-2	0	NO ODOR	0-2	0	NO ODOR
2-4	0	NO ODOR	2-4	0	NO ODOR
4-6	0	NO ODOR	4-6	0	NO ODOR

TABLE 1 (CONT'D)
ORGANIC VAPOR CONCENTRATIONS
SOIL VAPOR SURVEY
BUILDING 1346, CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

LOCATION			LOCATION		
DEPTH (FT)	OVA READING (PPM)	REMARKS	DEPTH (FT)	OVA READING (PPM)	REMARKS
D-1			D-5		
0-2	15	NO ODOR	0-2	3	NO ODOR
2-4	7	NO ODOR	2-4	9.8	NO ODOR
4-6	9	NO ODOR	4-6	200	NO ODOR
1-1A			1-2A		
0-2	21.9	NO ODOR	0-2	0.8	NO ODOR
2-4	49.6	ODOR	2-4	1.2	NO ODOR
4-6	652	STRONG ODOR	4-6	3.6	NO ODOR
1-3A			1 - -2A		
0-2	0.8	NO ODOR	0-2	0	NO ODOR
2-4	1.0	NO ODOR	0-2	0	NO ODOR
4-6	3.8	NO ODOR	4-6	0	NO ODOR
1 - -3A			1 - -4A		
0-2	0	NO ODOR	0-2	0	NO ODOR
2-4	0	NO ODOR	2-4	0	NO ODOR
4-6	0	NO ODOR	4-6	540	STRONG ODOR
1 - -5A			2 - -5A		
0-2	0	NO ODOR	0-2	0	NO ODOR
2-4	0	NO ODOR	2-4	0	NO ODOR
4-6	0	NO ODOR	4-6	0	NO ODOR

STARTUP BLANK
RERUN
NO INJECTION

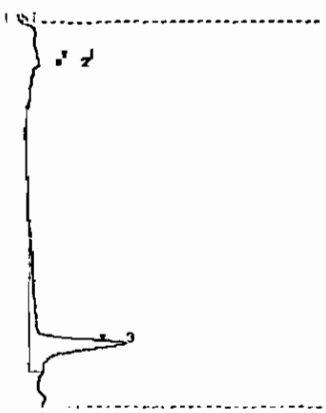
#1



CHANGED SEPTA

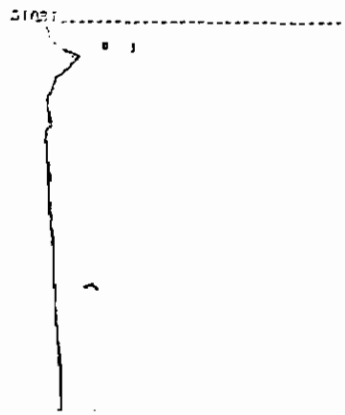
NO INJECTION

#2



INCREASE ANALYSIS
TIME TO 600 SEC
NO INJECTION

#3



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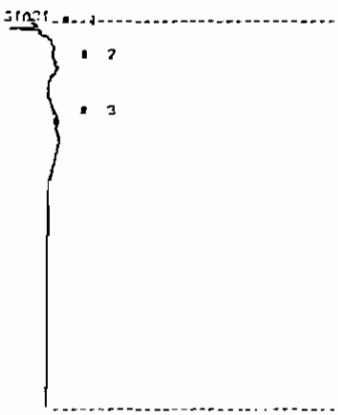
NO INJECTION

#4



100 µl INJECTION
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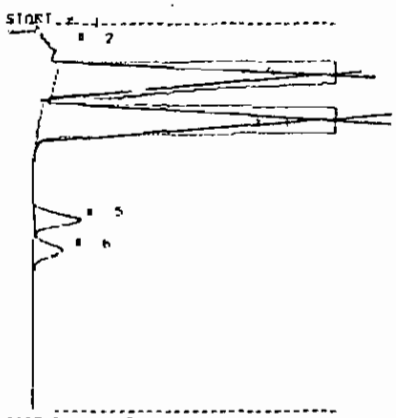
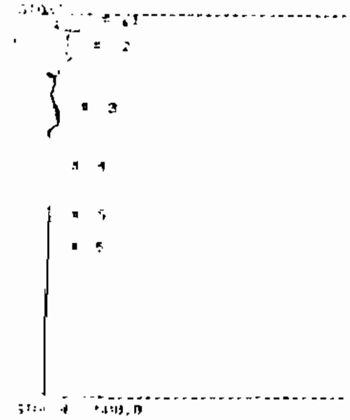
#5



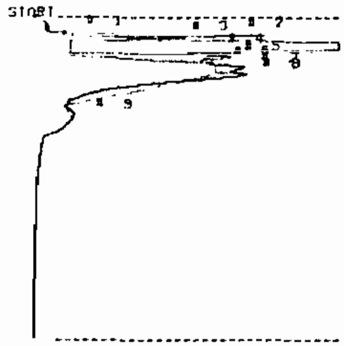
500 PPb STANDARD
VAPOR #6



SAMPLE LIBRARY 1 MAR 24 1992 10:02
ANALYSIS # 7 [illegible] CALIBRATE
INTERNAL TEMP [illegible] [illegible]
GAIN 50 100% INJECTION

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	1	28.2	64.1 mVS
BENZENE	*2	27.3	0.861 PPB
TOLUENE	3	122.2	0.393 PPB
[illegible]	5	335.2	1.900 PPB
[illegible]	6	392.2	4.102 PPB

#7 BLANK



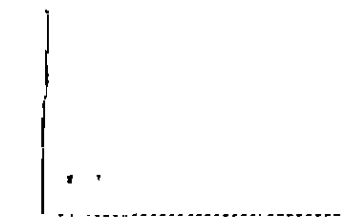
SAMPLE LIBRARY 1 MAR 24 1992 10:40P
ANALYSIS # 8 BORING-1 SOIL
INTERNAL TEMP 25 MAXI EXCHANGE
GAIN 50 100% INJECTION

COMPOUND NAME	PEAK	R.T.	AREA/PPB
UNKNOWN	1	26.4	42.5 mVS
UNKNOWN	2	30.4	1.2 VS
UNKNOWN	3	33.3	1.2 VS
UNKNOWN	4	43.3	31.3 VS
UNKNOWN	5	51.7	2.5 VS
BENZENE	6	73.3	0.852 PPB
BENZENE	7	81.7	1.640 PPB
BENZENE	8	97.5	0.258 PPB
TOLUENE	9	152.6	0.232 PPB

BORING (SOIL)
#1

B - 1.6 PPb
T - <1 PPb
X - ND

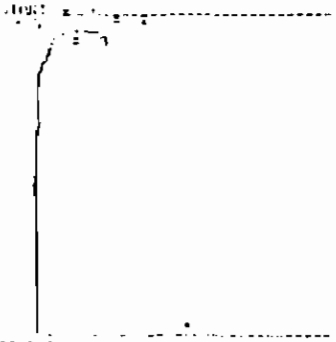
SOIL BORING B-1



System Blank · OK

Boring 2
B - <1
T - 5.0
X - ND

BORING B-2



Syringe Blank OK

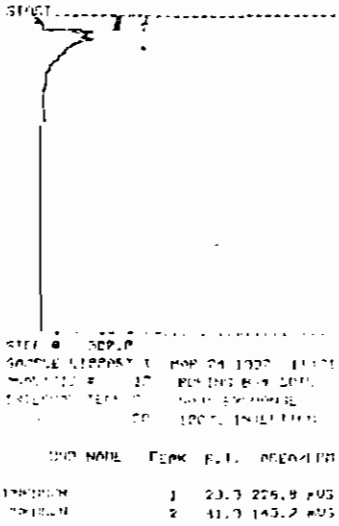
B - ND

T - ND

X - ND

BORING B-3

* PRIOR SAMPLE CLEAN
NO BLANK RAN



B - ND

T - ND

X - ND

BORING B-4

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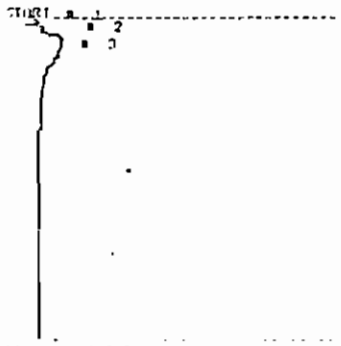

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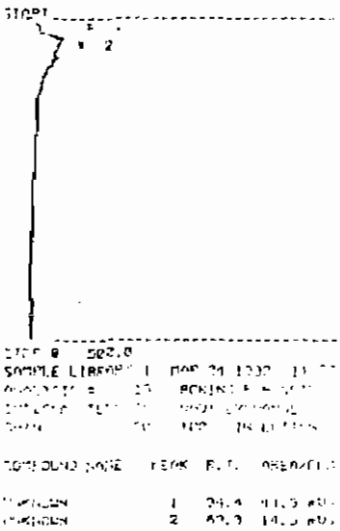
T- ND
X- ND

BORING B-5



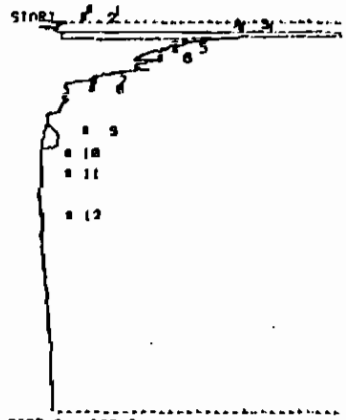
B - ND

T - ND

X - ND

BORING B-6

PHOTOVAC

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STOP 0   600.0
SAMPLE LIBRARY 1   FEB 28 1992  13: 4
ANALYSIS #    12   HAUT BASE
INTERNAL TEMP 33   .D-5 4-OFT
GAIN          100  1PPUL INJECTION

COMPOUND NAME     TIME%  P.A.   WEIGHT%

UNKNOWN             1    2.2   51.4 PPB
UNKNOWN             2   11.9   50.0 PPB
UNKNOWN             3   21.2   15.1  %
UNKNOWN             4   30.8    1.2  %
UNKNOWN             5   [illegible] 250.1 PPB
UNKNOWN             7   110.2   46.2 PPB
UNKNOWN             8   122.4   [illegible] PPB
UNKNOWN             9   196.2    1.1  %
UNKNOWN            10   [illegible]  [illegible] PPB
UNKNOWN            11   202.8   27.8 PPB
UNKNOWN            12   217.1  200.1 PPB
```

Clear

Survey Location D-5

"FINAL"
SUMMARY OF INITIAL ABATEMENT ACTIONS, INITIAL SITE CHARACTERIZATION, SOIL/GROUNDWATER ASSESSMENT WORK PLAN

BUILDING #1346
NAVY EXCHANGE SERVICE STATION
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

August 7, 1991

Prepared for:

Environmental Protection Division
Charleston Naval Shipyard
Charleston Naval Base
Charleston, South Carolina

Prepared by:

Westinghouse Environmental
and Geotechnical Services, Inc.
840 Low Country Boulevard
Mount Pleasant, South Carolina 29464

Westinghouse Environmental
and Geotechnical Services, Inc.

840 Low Country Boulevard
P.O. Box 1551
Mt. Pleasant, South Carolina 29464
(803) 884-0005
Fax (803) 881-6149

August 7, 1991

Environmental Protection Division
Charleston Naval Shipyard
Charleston Naval Base
Charleston, South Carolina 29408-6100

Attention: Mr. J.W. Sneed

Subject: Initial Abatement Action, Initial Site Characterization
Soil/Groundwater Assessment Work Plan (Final Report)
Building #1346
Navy Exchange Service Station
Charleston Naval Base
Charleston, South Carolina
Westinghouse Environmental and Geotechnical Services, Inc.
Job #CSWA079

Dear Mr. Sneed:

Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) is pleased to submit the final submittal of the Work Plan for the subject site.

Comments by your Mr. Karl Ray and Mr. L. Guthrie were recieved on August 5, 1991 and incorporated into the report. Enclosed are four copies of the report for your use. We have provided two bound copies for South Carolina Department of Health and Environmental Control (SCDHEC) review and two unbound copies for your use, as directed by Mr. Guthrie. If additional copies are needed please let us know.

If you have any questions, please contact Hugh Connolly or John Albrecht at 884-0005.

Sincerely,

WESTINGHOUSE ENVIRONMENTAL
AND GEOTECHNICAL SERVICES, INC.

Hugh Connolly
Project Hydrogeologist

John Albrecht, P.E.
Senior Environmental Engineer

HC/JA/ssj

Westinghouse Environmental
and Geotechnical Services, Inc.

840 Low Country Boulevard
P.O. Box 1551
Mt. Pleasant, South Carolina 29464
(803) 884-0005
Fax (803) 881-6149

August 8, 1991

The LPA Group of North Carolina
P.O. Box 17736
Raleigh, North Carolina 27619

Attention: Mr. Gary Green

Subject: Initial Abatement Action, Initial Site Characterization
Soil/Groundwater Assessment Work Plan (Final Report)
Building #1346
Navy Exchange Service Station
Charleston Naval Base
Charleston, South Carolina
Westinghouse Environmental and Geotechnical Services, Inc.
Job #CSWA079

Dear Mr. Green:

Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) is pleased to provide a copy of the Final Report of the subject site for your information.

If you have any questions, please call Hugh Connolly or John Albrecht at (803) 884-0005.

Sincerely,

WESTINGHOUSE ENVIRONMENTAL
AND GEOTECHNICAL SERVICES, INC.

Hugh Connolly
Project Hydrogeologist

John Albrecht, P.E.
Senior Environmental Engineer

HC/JA/ssj

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1.0 INTRODUCTION

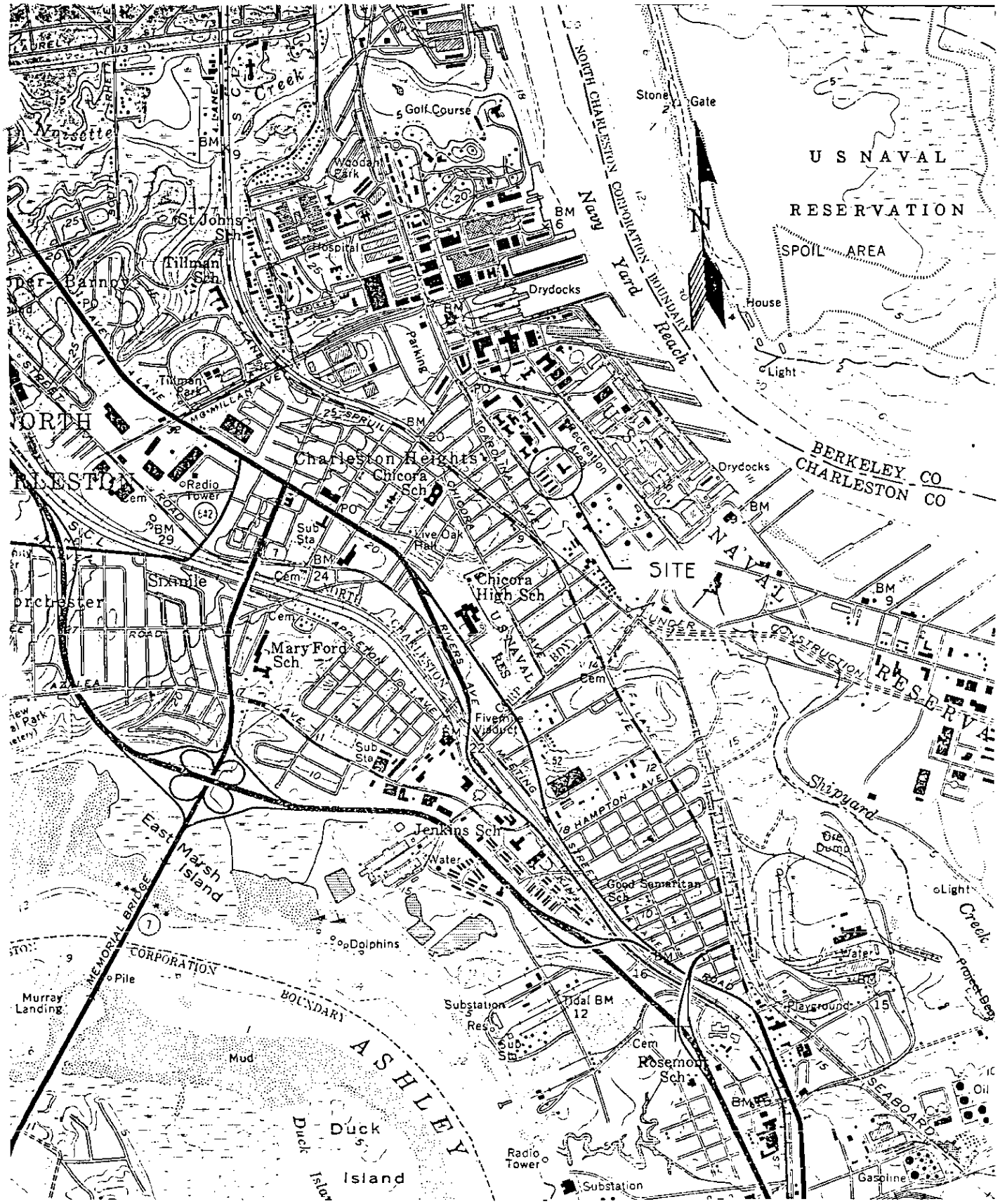
The subject site is a retail gasoline service station denoted as Building #1346 on the Charleston Naval Base in Charleston, South Carolina. A location plan for the site is presented as Figure 1.

The Exchange Service Station presently has eleven Underground Storage Tanks (USTs) buried on-site. The first UST's to be installed consisted of four 4,000 gallon steel USTs situated within the same tank basin, and one remotely located 10,000 gallon steel UST. These tanks were reported in a 1987, Harding Lawson Associates report as being installed at least 20 years ago. The tanks are listed as tanks 1346-D, E, F, G and H. All of the tanks were reported as storing gasoline, were constructed of steel and had steel piping. The tanks were abandoned ranging from 6 - 15 years ago.

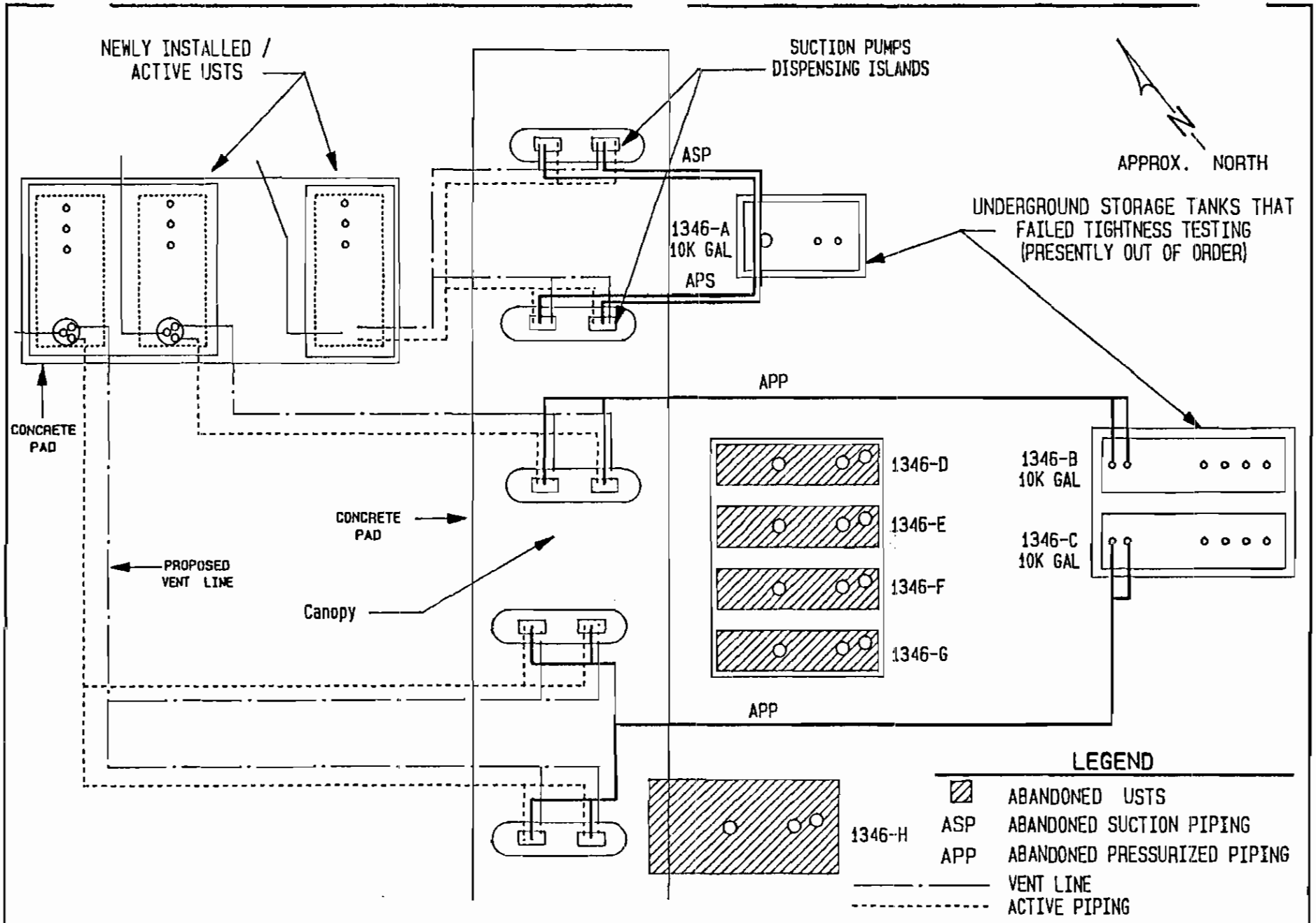
With the abandonment of the five tanks, the site was retrofitted with three 10,000 gallon steel tanks numbered #1346-A, B and C. The tanks have steel piping and are used for storage of gasoline. Tank #1346-A was reportedly installed 11-15 years and tanks #1346-B and C were installed 6-10 years prior to the Harding Lawson Report. Two USTs, presumably tanks #1346-B and C, are situated within the same tank basin. The third UST is remotely located in an isolated tank basin to the north near the two northern most dispensing islands. All UST locations at the site are as shown on Figure 2.

The tanks #1346-A, B and C were taken out of operation in February 1991, following a failed tank tightness test. The results of the test and initial abatement measures are summarized later in this report.

The site presently has three new 10,000 gallon fiberglass tanks with single walled fiberglass piping. Two of the tanks have pressurized piping systems, while one of the tanks is a suction system. All of the tanks were installed this year and are now in operation.



SCALE: 1 : 24000	DRAWN BY: HSC	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29464 (803) 884-0005	TITLE: SITE LOCATION PLAN BLDG. #1346 CHARLESTON NAVAL BASE, S.C.	FIGURE: 1
DATE: 8-7-91	CHECKED BY: HSC			
JOB NO: CSWA079	APPROVED BY:			



SCALE: 1" = 20'	DRAWN BY: WJM	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29464 (803) 884-0005	TITLE: SITE PLAN BUILDING 1346, GASOLINE SERVICE STATION CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA	FIGURE 2
DATE: 8-7-91	CHECKED BY: JK			
JOB NO: CSWA079	APPROVED BY: GLB			

As a result of the failed tank tightness test, Westinghouse was contracted to perform a Site Closure Assessment dated March 21, 1991, to measure for the presence of a release where contamination was most likely to be present. Analytical results for soil samples collected within the UST basins, along product piping, and at the pump island indicated the presence of petroleum hydrocarbon related contamination at varying levels confirming that a release had occurred.

During the site closure assessment, additional soil samples were collected from proposed UST and pipeline locations at the site where additional USTs were to be installed. This was done in an attempt to determine if and to what degree, contamination may be encountered upon soil excavation resulting from new UST installations. Low level contamination was detected in the soil samples collected from the proposed UST and pipeline locations and as a result the excavated soil and groundwater resulting from the dewatering operations was required to be abated according to the SCDHEC regulations, standards and guidelines. Shortly after the site closure assessment was submitted to the SCDHEC, the new USTs and piping at the site were installed and pumping operations were resumed.

The SCDHEC responded to Westinghouse's Site Closure Assessment in their correspondence dated May 8, 1991, requesting that a summary of the initial abatement actions, an initial site characterization, method of free product recovery, and an assessment plan addressing the potential for groundwater impact be submitted.

In late June 1991, Westinghouse was retained to prepare a written report satisfying the requirements set forth in the above referenced SCDHEC correspondence. The following report has been prepared to satisfy these requirements.

1.1 Summary of Initial Abatement Measures

To satisfy the South Carolina State UST Regulation R.61-91, Part 280, Subpart D, requirements for leak detection, the operational 10,000 gallon USTs (#1346-A, B and C) at the site were tested for tightness on February 3, 1991. Preliminary data for the USTs collected during the testing in the field indicated that all three of the USTs were leaking. The official report was finalized on February 8, 1991. Copies of the tank tightness testing results are provided as Appendix I. On February 15, 1991, verbal notification of the test failures was made to the local SCDHEC office, Trident District (EQC).

Verbal permission was obtained from the Trident District EQC to operate the facility through the weekend to minimize the amount of product that would need to be pumped out of the USTs on the following Monday. On Monday, February 18, 1991, the remaining product within the USTs was pumped out, and the USTs were taken out of service. The site was then scheduled for installation of new USTs and piping.

In early March 1991, to satisfy the requirements set forth in the South Carolina State UST Control Regulation R.61-92, Part 280, Subpart "F", Section 280.62, Westinghouse was contracted to perform a site closure assessment at the gasoline service station site. Soil samples were collected within the UST basins, along product pipelines and at the pump islands. Significant levels of petroleum hydrocarbon contamination were found in many of the soil samples collected with varying degrees of contamination detected in all soil samples collected at the site. However, no free product was noted with the soil borings performed. Westinghouse's closure assessment report concluded that a significant release had occurred from the USTs at the site, impacting the soils associated with the UST basins, product pipelines and dispenser island. Also, based upon the depths at which some of the samples were obtained (soil/groundwater interface), it was reported that the groundwater beneath the site had likely been impacted. A copy of the closure assessment report is provided as Appendix II.

The service station site is covered with concrete pads and asphalt. Upon site inspection no signs of contamination were noted on the surface or with associated drainage ditches.

2.0 INITIAL SITE CHARACTERIZATION

The following initial site characterization section of this report has been prepared to satisfy the requirements set forth in the South Carolina State UST Regulation R.61-92, Part 280, Subpart "F", Section 280.63. Also, justification for not implementing free product removal at this time will be presented within this section.

2.1 Introduction

Based upon results of the annual tank tightness tests performed upon the three 10,000 gallon gasoline USTs located at the Charleston Navy Base, the USTs were taken out of service and a site closure assessment was performed. Analytical results for soil samples collected in conjunction with the closure assessments indicated that a significant release had occurred from the USTs, impacting the soils. At that time, it was also suspected that groundwater had been impacted due to the depth of the soil contamination.

No free floating petroleum product was encountered during the closure assessment. However, during the installation of three new 10,000 gallon gasoline USTs at the site, on or about May 29, 1991, free product was encountered. Free product removal is discussed later in the report (see Section 2.3).

2.2 Nature of the Release

The USTs at the site contained various grades of unleaded gasoline, regular unleaded, unleaded plus and super unleaded. Daily stick readings were performed upon the UST with monthly reconciliation for the purposes of accountability and release detection. Utilizing the USEPA inventory control requirements, inventory control was at an allowable variance of one percent plus or minus 130 gallons. The inventory performed on a monthly basis at Building #1346 was within the one percent margin. As a result, it is not possible to determine the amount of product released to the environment through accountability records.

2.3 Free Product Removal

The site closure assessment performed at the site did not detect any free product in the hand auger borings performed at the site. However, free product was encountered upon installation of the product delivery lines on or about May 29, 1991 in the pipeline trenches between the outermost islands along the northern border of the site. The free product was pumped from the excavation into 55 gallon drums. Approximately 385 gallons of product/water was pumped from the excavation. The liquid was treated as a hazardous waste and properly disposed of by the Navy.

South Carolina State UST regulation R.61-92, Part 280, Subpart "F", Section 280.64(a) states that free product removal should be conducted utilizing techniques appropriate to the hydrogeologic conditions at the site, etc. Presently, the location of any free product and the existing hydrogeologic conditions at the site are unknown. Therefore, Westinghouse believes that the data expected to result from the following work plan (Section 3.0) should be evaluated prior to making any additional efforts to locate and recover free product. Any free product encountered during the soil/groundwater assessment will be identified and a suitable method of recovery may be recommended in our final report.

2.4 Existing Site Conditions

As previously discussed, Building #1346 is a gasoline service station located on the Charleston Naval Base. The following information was researched to aid in determining the potential threat the site possess to human health.

2.4.1 Land Use

The Charleston Naval Base is located in the industrialized neck area of Charleston, South Carolina and consists of approximately 1400 acres of developed land. The base has been an active military installation since 1901. The base provides employment for both military and civilian personnel. The northern portion of the base consists of military housing and recreational facilities, various building structures and a series of piers and drydocks for berthing

military vessels. The Charleston Naval Shipyard comprises much of the northern portion of the Naval Base, just south of the housing and recreational area. The southern portion of the installation, in the area in which the study site is located, consists of base operations, maintenance and production dedicated to routine operations of the Charleston Naval Station, and other tenant commands. A few community recreational facilities are also located in this area as well as a bachelor housing section located on the southern tip of the installation.

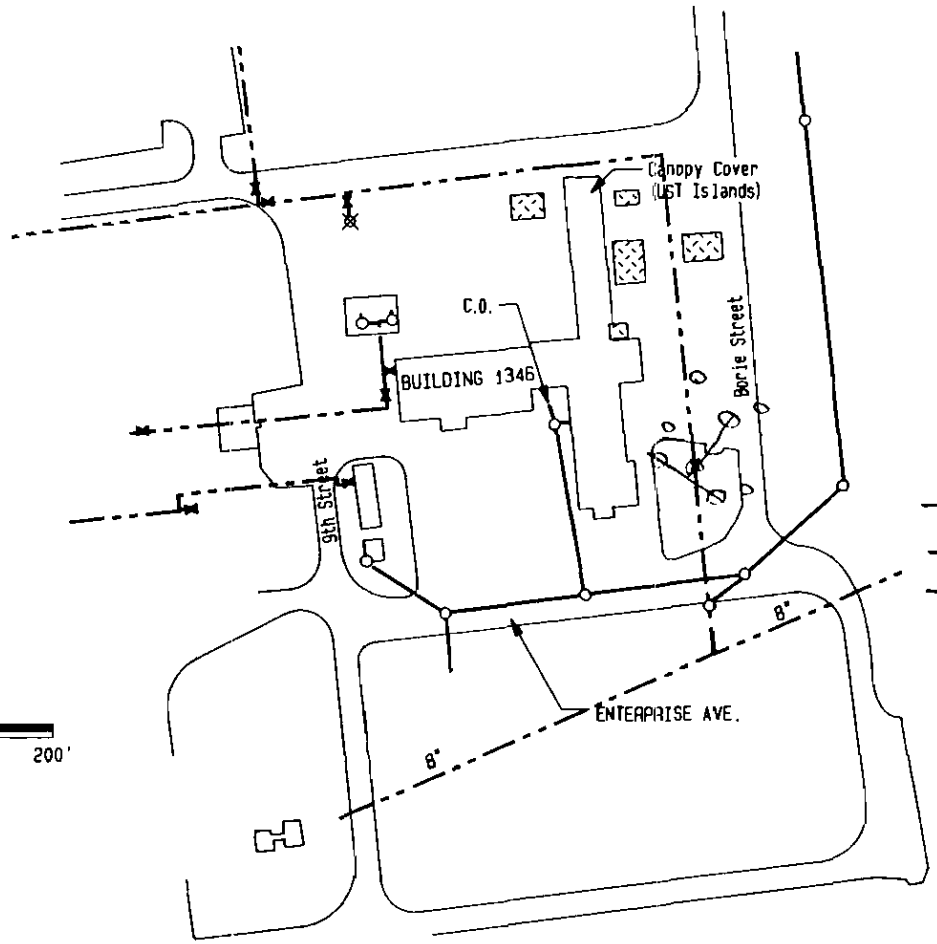
The base is bounded on the east by the Cooper River. In this area are located a series of piers utilized for the berthing of military surface craft. The base is bounded on the west by light to heavy industrial, commercial and residentially zoned areas, characteristic of the neck area of Charleston, South Carolina.

2.4.2 Site Utilities

Site utility plans for Building #1346 were provided by the Engineering Section of the Charleston Naval Base. The utilities are shown on the utility location plan (Figures 3A and 3B). Utilities on-site consist of water, sewer, electrical, natural gas and storm drain lines.

2.4.3 Quality of Shallow Groundwater

Charleston Naval Base purchases potable water from the City of Charleston Commissioners of Public Works. Groundwater is not used on the base as a source of drinking water. The waters of the surficial aquifer in the area of the Charleston Naval Base are classified as class "GB" as are all groundwaters in the State of South Carolina. The classification "GB" represents available sources of drinking water. Contaminant levels for respective constituents are as set forth in the State of South Carolina/EPA Primary Drinking Water Regulations.



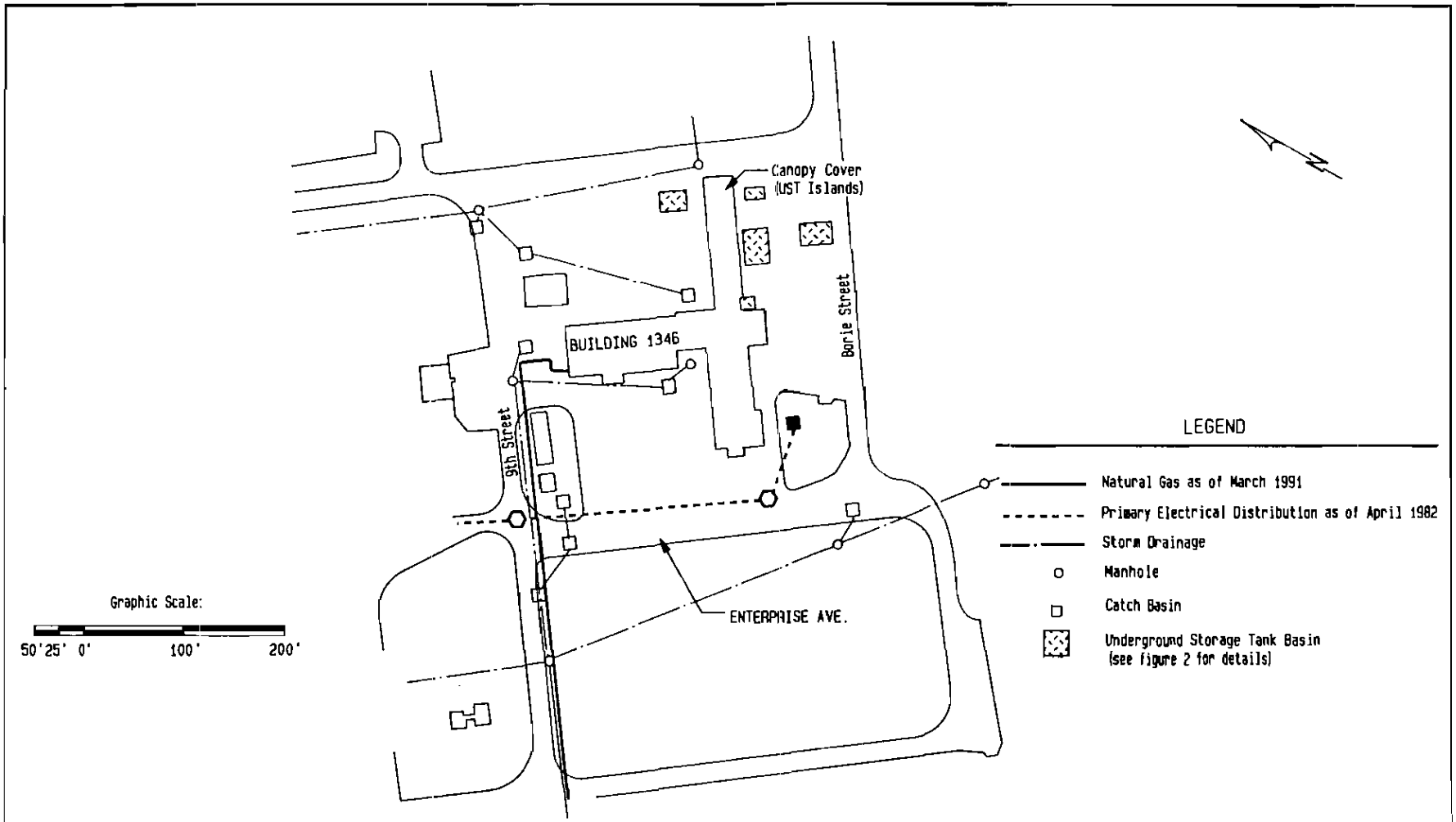
Graphic Scale:

50' 25' 0' 100' 200'

LEGEND

- 8 Inch Sewage Collection System as of May, 1990
- Freash Water Distribution System
- C.O. Clean Out
- Valve
- Fire Hydrant
- Manhole
- Underground Storage Tank Basin (see figure 2 for details)

SCALE: 1" = 100'	DRAWN BY: WJM	REVISION DATE:	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29464 (803) 884-0005	TITLE: UTILITY LOCATION PLAN BLDG. 1346 GASOLINE SERVICE STATION CHARLESTON NAVAL BASE, S.C.	FIGURE: 3A
DATE: 8-7-91	CHECKED BY:	REVISION DATE:			SHEET 1 OF 1
JOB NO.: CSWA079	APPROVED BY:	REVISION DATE:			



SCALE: 1" = 100'	DRAWN BY: WJM	REVISION DATE:	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29464 (803) 884-0005	TITLE: UTILITY LOCATION PLAN BLDG. 1346 GASOLINE SERVICE STATION CHARLESTON NAVAL BASE, S.C.	FIGURE: 3B
DATE: 8-5-91	CHECKED BY: JTC	REVISION DATE:			
JOB NO.: CSWA079	APPROVED BY: JHH	REVISION DATE:			SHEET 1 OF 1

Although the waters of the surficial aquifer in the area are classified as a drinking water source, these waters are generally not used for this purpose. Due to the highly industrialized nature of the neck area of Charleston, South Carolina, the surficial aquifer is generally affected by various environmental impacts resulting from such things as former creosote manufacturing plants, petroleum refineries and bulk petroleum storage tanks.

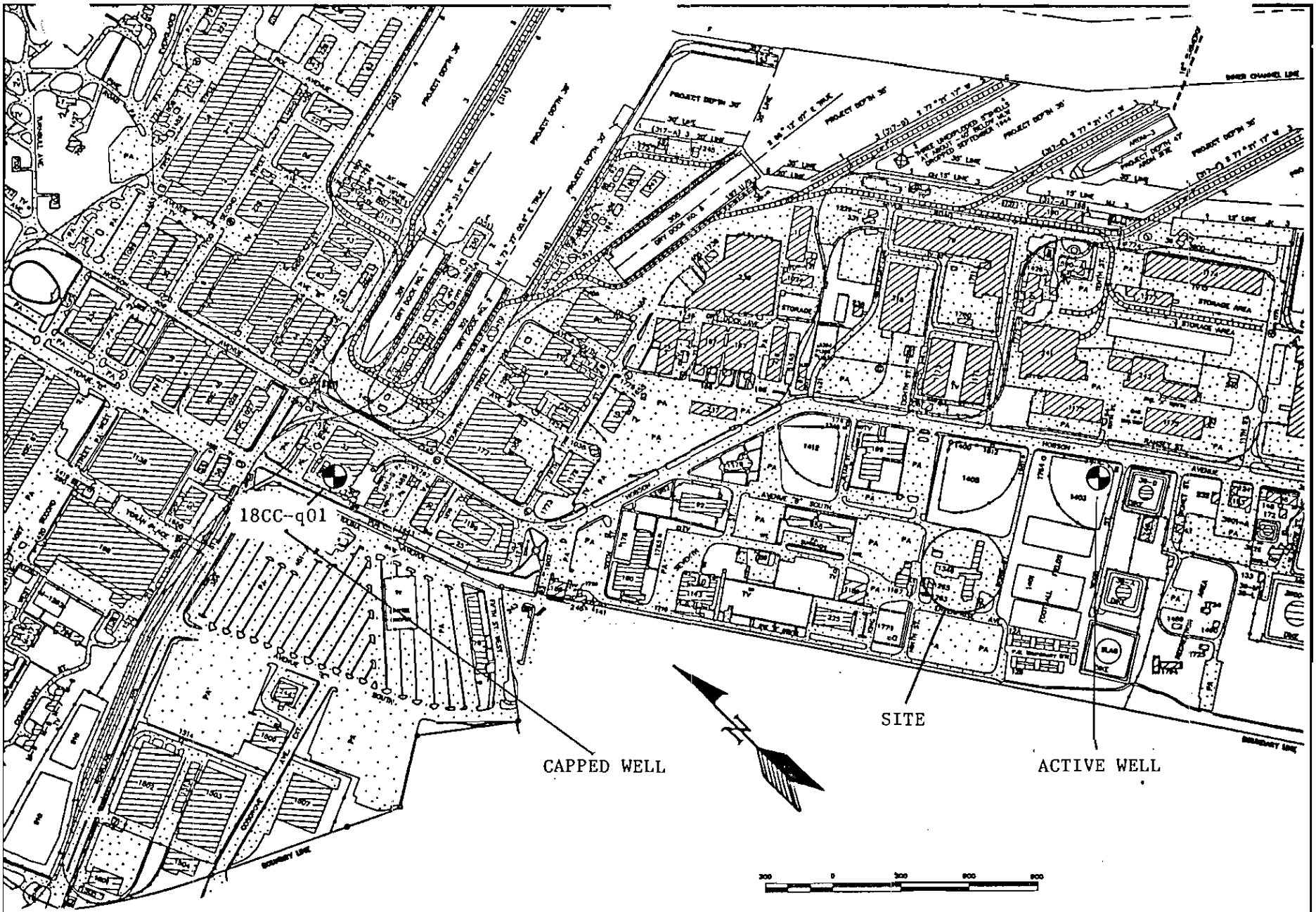
2.4.4 Use and Location of Wells Potentially Affected by Release

Contact was made with the South Carolina Water Resource Commission (SCWRC) to determine the location of any groundwater supply wells within a one-mile radius. Three wells were reported to be within a one-mile radius; however, it was determined upon inspection of the data that two of the wells were recorded in error and that only one well listed was actually within a one-mile radius of the affected area. The SCWRC well number 18CC-q01, or Charleston County well number CHN-0476, owned by the Charleston Naval Shipyard, is used for industrial purposes. However, the SCWRC report form listing data and nomenclature on this well indicates that the well has been capped and is no longer in use. The report form is included as Appendix III.

Interviews with Charleston Naval Base personnel indicated that there is another well located nearby that is still in operation. This well is located approximately 900 feet east of the site and supplies water to a compressor house for cooling tower operations and is not used as a source of potable water. Both the location of the well listed by the SCWRC and the well identified by the Charleston Naval Base personnel are shown on Figure 4.

2.5 Geology

Geologically, Building #1346 is located within the confines of the Lower Coastal Plain Physiographic Province. Generally, the Coastal Plain Province is characterized by a successively overlapping wedge of sediments which forms a thin layer near the fall line and thickens to about 3000 feet in Southern Charleston County.



SCALE: 1" = 600'	DRAWN BY: JJC	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29464 (803) 884-0005	TITLE: GW SUPPLY WELL LOCATION BLDG. #1346 CHARLESTON NAVAL BASE, S.C.
DATE: 8-7-91	CHECKED BY: JJC		FIGURE 4
JOB NO: CSWA079	APPROVED BY:		

Sediments encountered while performing handauger borings on site include black to grey green silty clays that are lagoonal sediments characteristic of back barrier island sequences. Soft grey green clays are generally encountered down to the Cooper Formation.

The Cooper Formation (Eocene Age), specifically the Cooper Marl, at the site lies approximately 25 feet below land surface. Although it has some water bearing capacity, the Cooper Formation is regarded as a confining unit for the overlying shallow aquifer systems and as an aquitard protecting the underlying primary water bearing units.

2.6 Summary/Conclusions

Based upon the results of the tank tightness testing performed upon the most recently operational USTs, coupled with the analytical results for soil samples collected during the site closure assessment, Westinghouse concludes that a release has occurred at the site. Also based upon the depth at which some of the contaminated soil samples were collected (soil/groundwater interface), it is likely that groundwater, as well as the subsurface soils have been impacted at Building #1346.

Daily inventory and monthly reconciliations performed at the site while the subject USTs were in operation, were within the one percent plus 130 gallons, the EPA requirements, and as a result no product loss was shown. Westinghouse feels that to assume that one percent of the product sold monthly at the site was lost would be too large a number to attribute to the amount of product released, and is not realistic. Therefore, the amount of product released is still unknown at this time. The type of product lost is most likely a combination of the three grades of automotive gasoline distributed at the site, since all three tanks failed the tank testing.

The existing site use is primarily industrial, which is characteristic of the neck area of Charleston, South Carolina. Although surficial aquifer in the neck area has generally been adversely impacted by such industrial operations, the groundwater

is classified as GB by the state of South Carolina and is to be treated as a source of Drinking Water. As such, the South Carolina State Drinking Water Standards apply. However, the Charleston Naval Base is on city-supplied water and the groundwater well in the vicinity of Building #1346 is used for industrial purposes only. Research of available data and interviews with base personnel indicate the surficial aquifer is not a source for potable water in the immediate vicinity of the site.

The clayey and impermeable nature of the soils at the site should aid in site rehabilitation by retarding the spread and migration of the contaminants and limit the affected area that may require remediation. The relatively shallow depth at which the Cooper Marl is encountered at the site should limit the vertical extent of the contamination and serve to protect the deeper underlying aquifers that are used as a source for drinking water in other areas of Charleston.

The USTs are scheduled for removal, pending availability of funds and contract award. The Navy anticipates a contract will be awarded this calendar year with tank removal following thereafter.

Westinghouse recommends the following work plan be performed defining the vertical and horizontal extent of soil and possible groundwater contamination. The following sections of this report describe a work plan to address the detected contamination at the subject site.

3.0 SOIL/GROUNDWATER ASSESSMENT WORK PLAN

The following work plan has been prepared to satisfy the requirements set forth in the South Carolina State UST Regulation R.61-91, Subpart F, Section 280.65 as outlined in the SCDHEC correspondence dated May 8, 1991.

3.1 Introduction

Building #1346, gasoline service station, Charleston Naval Base, is located in Charleston, South Carolina. As a method of release detection, daily inventory with monthly reconciliation coupled with annual tank tightness testing was conducted at this site. Tank tightness testing for the three unleaded gasoline USTs recently operated at the site indicted that all three of the USTs were leaking. Westinghouse performed a UST closure assessment at the site. Analytical results for soil samples collected at the site indicted that a significant release had occurred and that it is likely that the groundwater at the site has been impacted.

3.2 Scope of Work

In response to the UST closure assessment for the Building #1346 performed by Westinghouse, the SCDHEC in their letter dated May 8, 1991, has requested that a work plan be submitted to define the extent and severity of the detected contamination. This work plan will involve the performance of a soil vapor survey, installation of groundwater monitoring wells, groundwater sampling and laboratory analysis and characterization of the surficial aquifer.

3.2.1 Soil Vapor Survey

To aid in defining the horizontal extent of the soil contamination and dissolved product plume, Westinghouse proposes to conduct a soil vapor survey at the site. A 50 foot grid pattern will be established at the site to serve as the respective vapor probe locations. At each location a carbon steel rod will be driven to a depth of 3.5 feet below grade. The rod will then be removed, a

length of steel tubing fitted to a Microtip Photoionization Detector (PID) will be administered to the driven hole, and organic vapor concentrations will be measured and recorded. This procedure will be repeated at each location until all measurements have been obtained. As the margins of the soil/groundwater contamination are located, the grid spacing will be decreased such that the exact location of the plume is determined. Prior to and in between each vapor probe location the critical equipment will be decontaminated with a chemically neutral surfactant and rinsed a minimum of three times with deionized water.

For confirmation of the data obtained from the vapor survey, handauger borings will be performed at key locations at the site. Soil samples will be collected down to the soil/groundwater interface at 2 foot intervals and placed in glass (16 oz.) mason jars with aluminum foil caps for headspace analysis utilizing the PID. The jars will be half-filled with soil and will be allowed to equilibrate for a minimum of five minutes at ambient air temperature. Boring logs will be produced describing the soils encountered and their respective contaminant concentrations. The open boreholes will be gauged for the presence of free product. The soil sample from each borehole that yields the highest level of contamination will be returned to our office for analysis by our portable gas chromatograph and be analyzed for benzene, toluene and xylene concentrations. It is estimated that approximately 8 handauger borings will be performed.

Once all the data has been collected from the vapor survey, the information will be plotted on a scaled site plan and a soil vapor isoconcentration map will be produced delineating the limits of the contaminated soil, the suspect contaminant plume and the approximate location of any free product plume encountered.

The isoconcentration map will be utilized for groundwater monitoring well placement when requesting permission to install the wells from the SCDHEC and will be included in our final report.

3.2.2 Groundwater Monitoring Well Installation

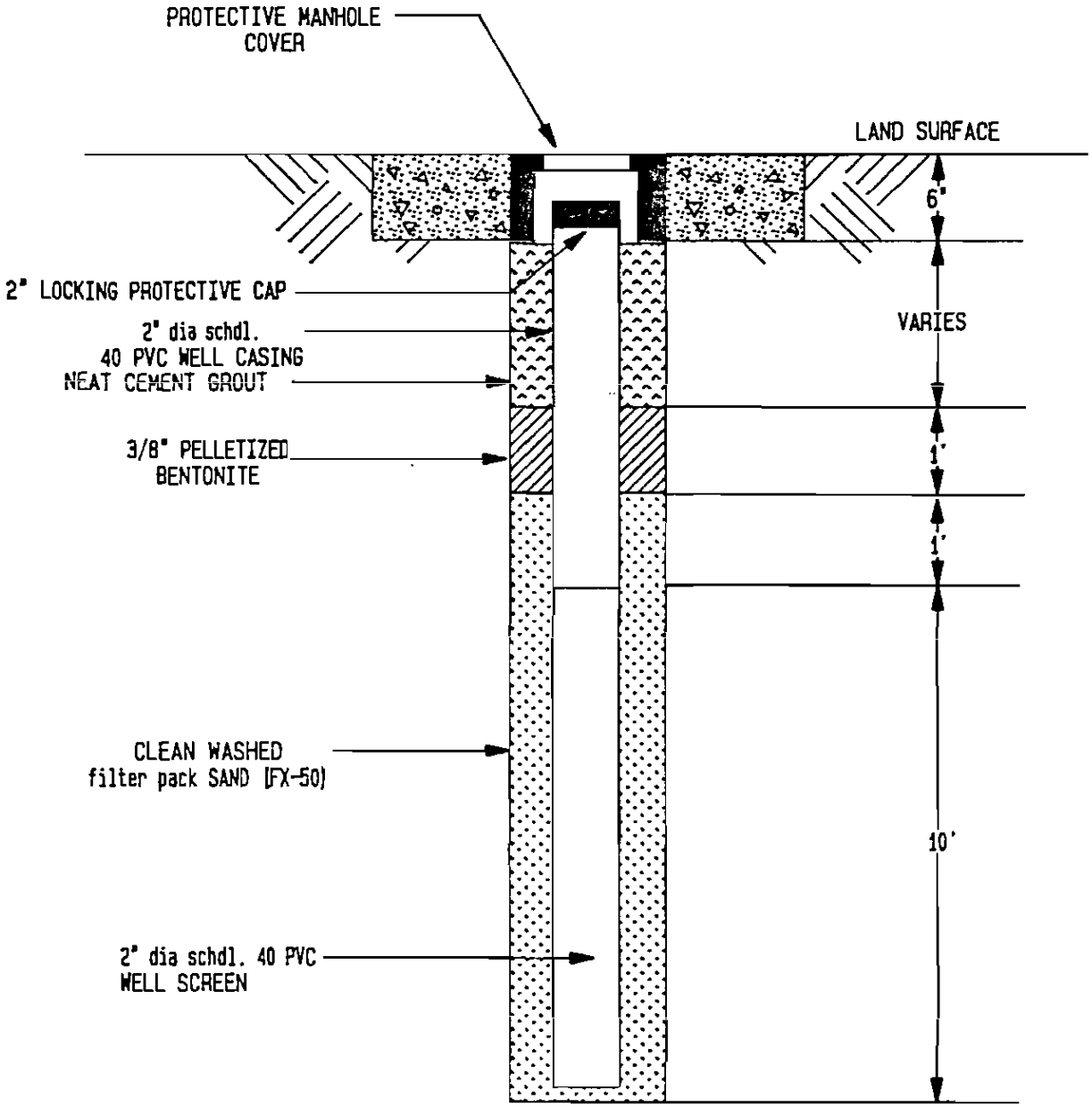
Westinghouse anticipates that 5 shallow (15 feet) groundwater monitoring wells and one deep groundwater monitoring well (25 feet) will be required to confirm the horizontal and vertical extent of the suspect groundwater contamination. The wells will be constructed as follows:

3.2.2.1 Shallow Groundwater Monitoring Wells

Five shallow groundwater monitoring wells will be installed at the study site based upon results of the soil vapor survey. These well locations will be strategically placed surrounding and within the contaminant plume and will be denoted as CNS-1346-1 through CNS-1346-5. The shallow wells will be constructed by augering a 6-inch diameter hollow stem auger into the subsurface to a depth of approximately 8-feet below the existing groundwater table. The boreholes will be converted to monitoring wells by the installation of a 2-inch diameter, Schedule 40 PVC casings and screens. The screen length in each well will be 10-feet and will have factory number 10 slot size (0.010 inches). A clean coarse washed filter sand (FX-50 or equivalent) will be installed by tremie to a depth of approximately 1.5-feet above the top of the screens. A bentonite pellet seal, one foot thick, will be installed above the filter sand. The remaining annulus of the wells will then be filled with a neat cement grout. The tops of the wells will be finished below grade in a protective bolt down manway, and will be equipped with locking caps. Figure 5 presents a typical well construction diagram for the shallow wells.

3.2.2.2 Deep Groundwater Monitoring Well

To minimize the potential for the introduction of petroleum related contaminants from the upper portion of the shallow aquifer to the deeper portion of the aquifer during drilling operations, a double cased telescoped well will be installed to assess the potential migration of the contaminants from the shallow to the deep portion of the aquifer. The deep monitoring well will be installed by



LE: NTS	DRAWN BY: WJM	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29464 (803) 884-0005	TITLE: TYPICAL WELL CONSTRUCTION DIAGRAM BUILDING 1346, GASOLINE SERVICE STATION CHARLESTON NAVAL BASE, S.C.	FIGURE: 5
DATE: 8-7-91	CHECKED BY: JJC			
JOB NO: CSWA079	APPROVED BY:			

first drilling a 10-inch diameter boring to a depth of approximately 5-feet below the existing groundwater table. A 6-inch diameter Schedule 40 PVC outer casing will be installed through the hollow stem of 10-inch auger and the annular space between the casing and the auger will be grouted to the surface by tremie with a neat cement. The auger will then be withdrawn and the grout within the boring will be allowed to become competent for a minimum of 24 hours. The deep well will then be advanced to a depth of approximately 15-feet below the 6-inch casing by drilling through the center of the 6-inch casing using a 5.75-inch diameter hollow stem auger. To convert the deep boring to a permanent monitoring well, a 2-inch diameter, 5-foot long of Schedule 40 PVC well screen (0.010-inch slot) will be set at the base of the borehole (approximately 35-feet). The 5-foot well screen will be connected to a 2-inch diameter Schedule 40 PVC riser pipe. An appropriately graded filter sand (FX-50 or equivalent) will be tremied around the annulus of the well opposite the well screen to one foot above the well screen. A bentonite layer (pellet form) 2-foot thick will be tremied around the annular space of the well above the filter sand. The remaining annular space of the well will be grouted by tremie to land surface using a neat cement grout. The well will be finished below grade in a protective vault and will also be equipped with a locking cap.

Upon completion of groundwater monitoring well installation, the tops of the well casings will be surveyed and drawn on a scaled site plan. The borehole cuttings will be drummed and remain on site until receipt of laboratory analysis. Disposal of the cuttings will be determined based on analytical results.

3.2.3 Sampling/Laboratory Analysis

Upon completion of groundwater monitoring well installation, the wells will be allowed to stand a minimum of 24 hours prior to development to allow the grout to become competent. The wells will then be developed by removing a minimum of 10 well volumes from each well to ensure seating of the filter pack. The development water will be drummed on-site until a transport arrives to pump out the drums and deliver the waste to an approved recycling facility.

Prior to development, the wells will be gauged for water and/or product level measurements. Those wells determined to contain free product will not be sampled. The water/product levels will be recorded and applied to the scaled site plan to produce a groundwater potentiometric surface map depicting the water level elevations for the surficial aquifer across the study site.

Upon completion of well development, the wells will be sampled and analyzed for purgeable aromatics by EPA method 602, Methyl Tert Butyl Ether (MTBE), Total Petroleum Hydrocarbons (TPH) by Gas Chromatography (GC) and Total Lead constituents. In the event that free product is encountered at the site, the well with the thickest amount of free product will be considered the worst case well. If free product is not encountered, then, based upon the results of the initial round of sampling, the well found to contain the highest concentrations will be considered the worst case well. The worst case well will be sampled and analyzed for the following analysis:

- EPA Method 601
- EPA Method 602
- Total and dissolved Lead
- Biochemical Oxygen Demand (BOD_5)
- tert Butyl Methyl Ether (MTBE)

The results from the worst case well analysis will provide vital information required to conceptually design a long term remedial action and treatment system for the site.

All groundwater samples will be collected utilizing disposable bailers brought to the site in factory sealed containers, placed into specially prepared sample containers, labelled and immediately refrigerated. Upon completion of sample collection, the samples will be shipped by overnight courier to Westinghouse's in-house laboratory in Charlotte, North Carolina for analysis. The standard ten working day turn around will be requested for laboratory analysis.

3.2.4 Surficial Aquifer Characterization

Westinghouse proposes to determine the surficial aquifer characteristics by performing field hydraulic conductivity tests (slug tests, Bouwer and Rice 1976) on three to five wells installed

at the study site. The field test procedure involves the rapid removal of a slug of water from the well column and measurement of the resulting rise in head over time. To ensure accurate data, a Hermit 1000C Data Logger and a stainless steel Insitu, Inc. brand pressure transducer with deconable chemical resistant teflon cabling will be fitted to the wells to monitor the rate of recovery after the slug has been removed. Once the hydraulic conductivity for the site has been determined, the rate of lateral groundwater flow will be calculated using Darcy's equation (Freeze and Cherry 1979).

3.3 REPORT PREPARATION

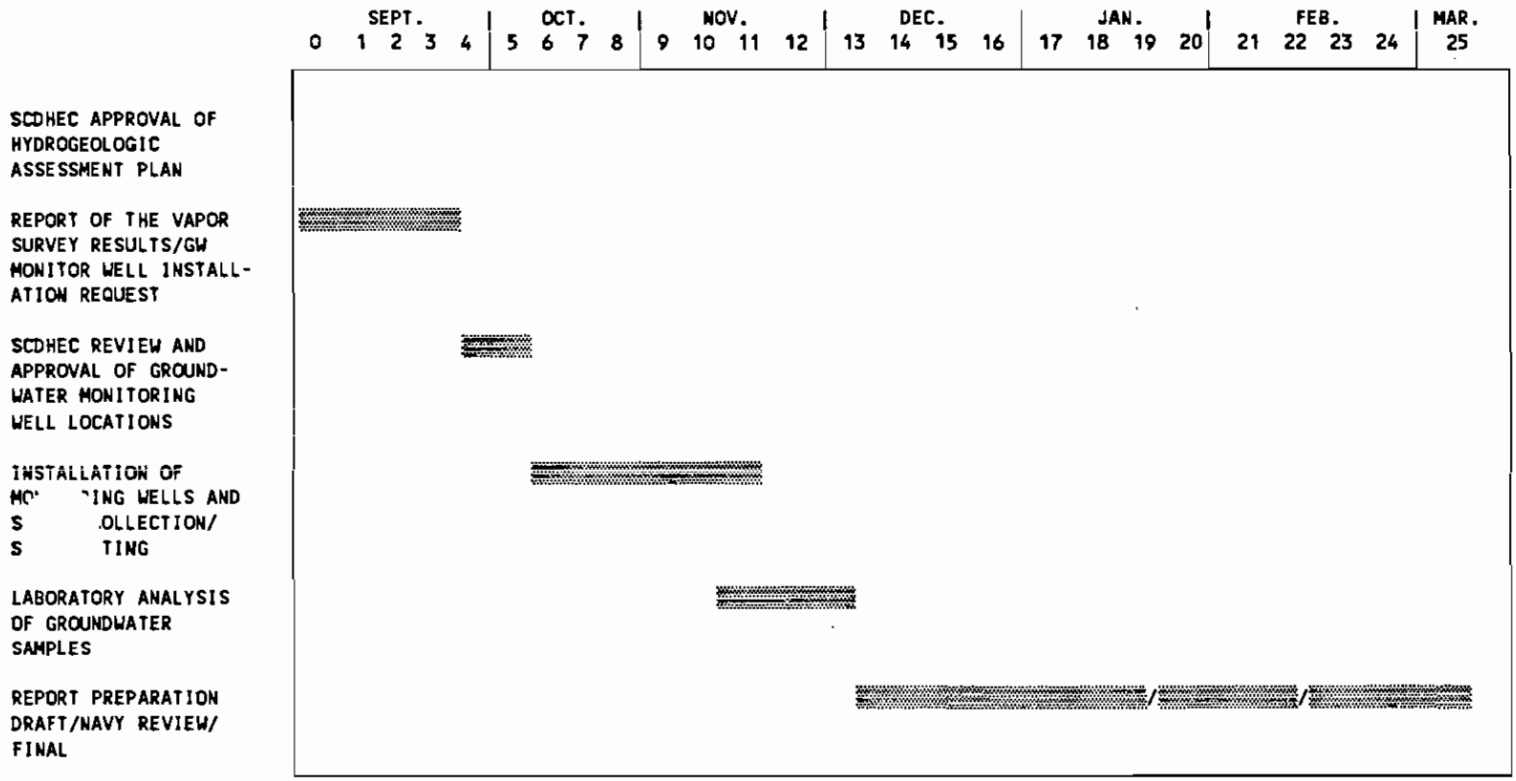
Upon completion of all the proposed field work, return of laboratory results and interpretation of the data, Westinghouse will prepare the Remedial Investigation Report which will detail our investigative procedures, findings, conclusions and recommendations. The report will include at a minimum:

- site background and conditions;
- soil vapor survey results and isoconcentration map;
- location and installation procedures of groundwater monitoring wells;
- soil and groundwater sampling protocol and analytical results;
- location of site utilities and nearby water supply wells;
- results of laboratory and field hydraulic conductivity testing; and
- rate and direction of groundwater flow.

3.4 IMPLEMENTATION SCHEDULE

Barring any unforeseen adverse weather conditions, Westinghouse is prepared to initiate site work immediately upon SCDHEC's approval of this plan. Following the soil vapor survey, a brief report of the results, scaled soil vapor concentration map, and recommendations for groundwater monitoring well locations will be submitted to the SCDHEC. An implementation schedule for our scope of work is provided as Table 1 for your review.

TABLE 1
IMPLEMENTATION SCHEDULE (in weeks)
SOIL/GROUNDWATER ASSESSMENT WORK PLAN
BUILDING #1346, NAVY EXCHANGE SERVICE STATION
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA



3.5 BIBLIOGRAPHY

Bouwer, H. and R.C. Rice. "A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells". Water Resources Research. V.12 (1976), 423-428.

Freeze, Allen R., John H. Cherry. Groundwater; Englewood Cliffs: Prentice Hall, Inc., 1979.

APPENDIX I

TANK TIGHTNESS TESTING RESULTS

Tank & Environmental Testing, Inc.

February 8, 1991

Mr. Jimmy LeCroy
Charleston Naval Ship Yard
Bldg. 12A, code 415
Charleston, S.C. 29408

Re: Tank tests for Charleston Naval Ship Yard
Charleston, S.C.

Dear Mr. LeCroy:

Enclosed is an invoice and a copy of the completed data sheets for the hydrostatic testing of the underground storage tanks tested by TET at the above referenced site. The three tanks were tested using the underfill method on February 3, 1991. The results of the testing are listed in the table below in gallons per hour (gph):

TANK	RESULTS	PASS/FAIL/INCONCLUSIVE
1 UNL. REG.	-.255 gph	FAIL
2 UNL. PLUS	-.239 gph	FAIL
3 UNL. SUPER	-.213 gpr	FAIL

The established criteria for passing/failing a hydrostatic test for tanks of this size is +/- .1 gph according to state and federal regulations. The testing was conducted using the Horner method in accordance with the NFPA and EPA and accepted by SCDHEC.

The results of the three underfill tank test indicates all three tanks failed their respective test according to the state and federal regulations. Therefore it is recommended that the all three tanks tested should be taken out of service. In addition, it is recommended that a preliminary hydrocarbon investigation be undertaken to determine the possibility of gasoline contamination within the subsurface environment in the area of the underground storage tanks.

1700 Alta Vista Drive, Suite 110 • Columbia, S.C. 29223 • (803) 754-3688, FAX (803) 754-7830

Encl

All pertinent data concerning the tests are included on these sheets. If you have any questions upon reviewing this, please call at 803-754-3688. We appreciate the opportunity to serve you.

Sincerely,

Sid Haviard

Sid Haviard
Director of Operations and,
Environmental Scientist

Tank & Environmental Testing, Inc.

CHARLESTON NAVAL STATION
BLDG. 1346
CHARLESTON, S.C.
TANK TESTER VER 2.01

FUEL TYPE:	UNLEADED REG. UNDERFILL
CAPACITY TANK 1:	9950 GALLONS
TEMPERATURE COEFFICENT:	690 ppm/deg F
TEST CRITERIA	+0.000 GPH TO +0.000 GPH

02/03/91 TEST TIME FROM 18:57 TO 19:31
DATA ANALYSIS INDICATES:

A GROSS VOLUME CHANGE OF:	-0.125 GALLONS
A VOLUME CHANGE DUE TO TEMPERATURE OF:	+0.015 GALLONS
A LIQUID VOLUME RATE OF CHANGE OF:	-0.255 GPH
WITH A 95 % CONFIDENCE INTERVAL OF:	+/-0.003 GPH
	(-0.253 TO -0.258 GPH)

TESTER.....

CUSTOMER.....

1700 Alta Vista Drive, Suite 110 • Columbia, S.C. 29223 • (803) 754-3688, FAX (803) 754-7836

Tank & Environmental Testing, Inc.

CHARLESTON NAVAL STATION
BLDG. 1346
CHARLESTON, S.C.
TANK TESTER VER 2.01
FUEL TYPE: UNLEADED PLUS UNDERFILL
CAPACITY TANK 2: 9802 GALLONS
TEMPERATURE COEFFICENT: 683 ppm/deg F
TEST CRITERIA +0.000 GPH TO +0.000 GPH

02/03/91 TEST TIME FROM 18:57 TO 19:31
DATA ANALYSIS INDICATES:

A GROSS VOLUME CHANGE OF:	-0.106 GALLONS
A VOLUME CHANGE DUE TO TEMPERATURE OF:	+0.025 GALLONS
A LIQUID VOLUME RATE OF CHANGE OF:	-0.239 GPH
WITH A 95 % CONFIDENCE INTERVAL OF:	+/-0.004 GPH
	(-0.235 TO -0.243 GPH)

TESTER.....

CUSTOMER.....

1700 Alta Vista Drive, Suite 110 • Columbia, S.C. 29223 • (803) 754-3688, FAX (803) 754-7836

Tank & Environmental Testing, Inc.

CHARLESTON NAVAL STATION
BLDG. 1346
CHARLESTON, S.C.
TANK TESTER VER 2.01
FUEL TYPE: UNLEADED SUPER UNDERFILL
CAPACITY TANK 3: 10172 GALLONS
TEMPERATURE COEFFICENT: 673 ppm/deg F
TEST CRITERIA +0.000 GPH TO +0.000 GPH

02/03/91 TEST TIME FROM 14:30 TO 15:37
DATA ANALYSIS INDICATES:

A GROSS VOLUME CHANGE OF:	-0.127 GALLONS
A VOLUME CHANGE DUE TO TEMPERATURE OF:	+0.123 GALLONS
A LIQUID VOLUME RATE OF CHANGE OF:	-0.213 GPH
WITH A 95 % CONFIDENCE INTERVAL OF:	+/-0.002 GPH
	(-0.211 TO -0.216 GPH)

TESTER.....

CUSTOMER.....

1700 Alta Vista Drive, Suite 110 • Columbia, S.C. 29223 • (803) 754-3688, FAX (803) 754-7836

APPENDIX II

SITE CLOSURE ASSESSMENT REPORT

CLOSURE ASSESSMENT REPORT
RETAIL FUEL DISTRIBUTION FACILITY
BUILDING #1346
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

Prepared for:

The LPA Group of North Carolina
38303 B Computer Drive, Suite 204
Raleigh, North Carolina 27619

Prepared by:

Westinghouse Environmental
and Geotechnical Services, Inc.
840 Low Country Boulevard
Mount Pleasant, South Carolina 29464
(803) 884-0005

Westinghouse Environmental
and Geotechnical Services, Inc.

840 Low Country Boulevard
P.O. Box 1551
Mt. Pleasant, South Carolina 29464
(803) 884-0005
Fax (803) 881-6149

March 21, 1991

The LPA Group of North Carolina
3803 B Computer Drive, Suite 204
Raleigh, North Carolina 27619

Attention: Mr. Gary Green

Subject: Closure Assessment Report
Building #1346, Charleston Naval Base
Charleston, South Carolina
Westinghouse Environmental and Geotechnical Services, Inc.
Job #CSWA079

Dear Mr. Green:

Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) is pleased to submit the enclosed Closure Assessment Report for the retail fuel distribution facility, Building #1346 located at the Charleston Naval Base in Charleston, South Carolina. This report is provided in general accordance with our proposal number 340-91-024 dated February 20, 1991. The following report describes our sampling methodology, the analytical results and our conclusions and recommendations.

If you have any questions concerning this report or if you require any additional information, please contact Hugh Connolly at (803) 884-0005.

Sincerely,

WESTINGHOUSE ENVIRONMENTAL
AND GEOTECHNICAL SERVICES, INC.

Hugh Connolly
Project Hydrogeologist

Sonny Chestnut, P.E.
Senior Environmental Engineer

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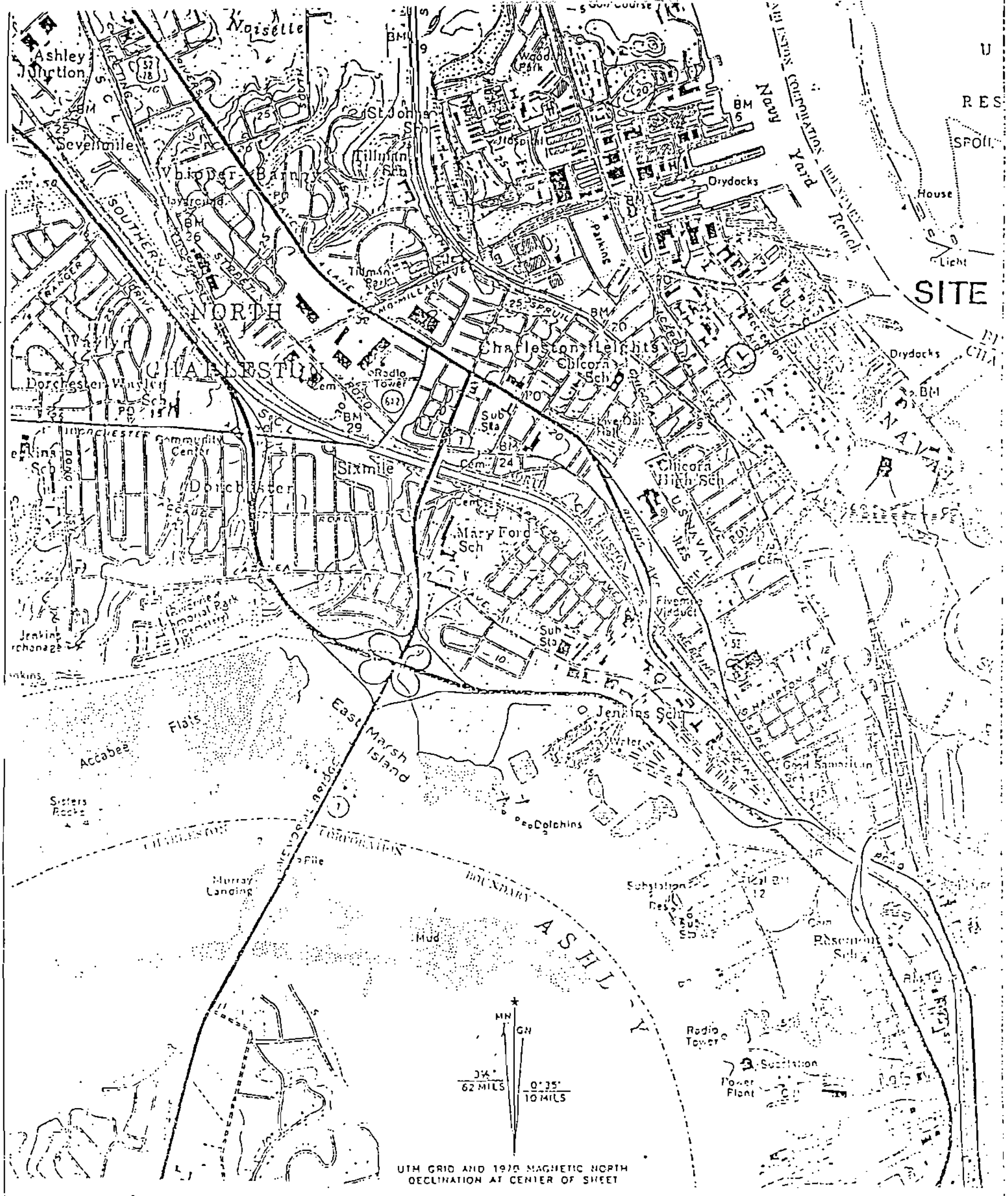
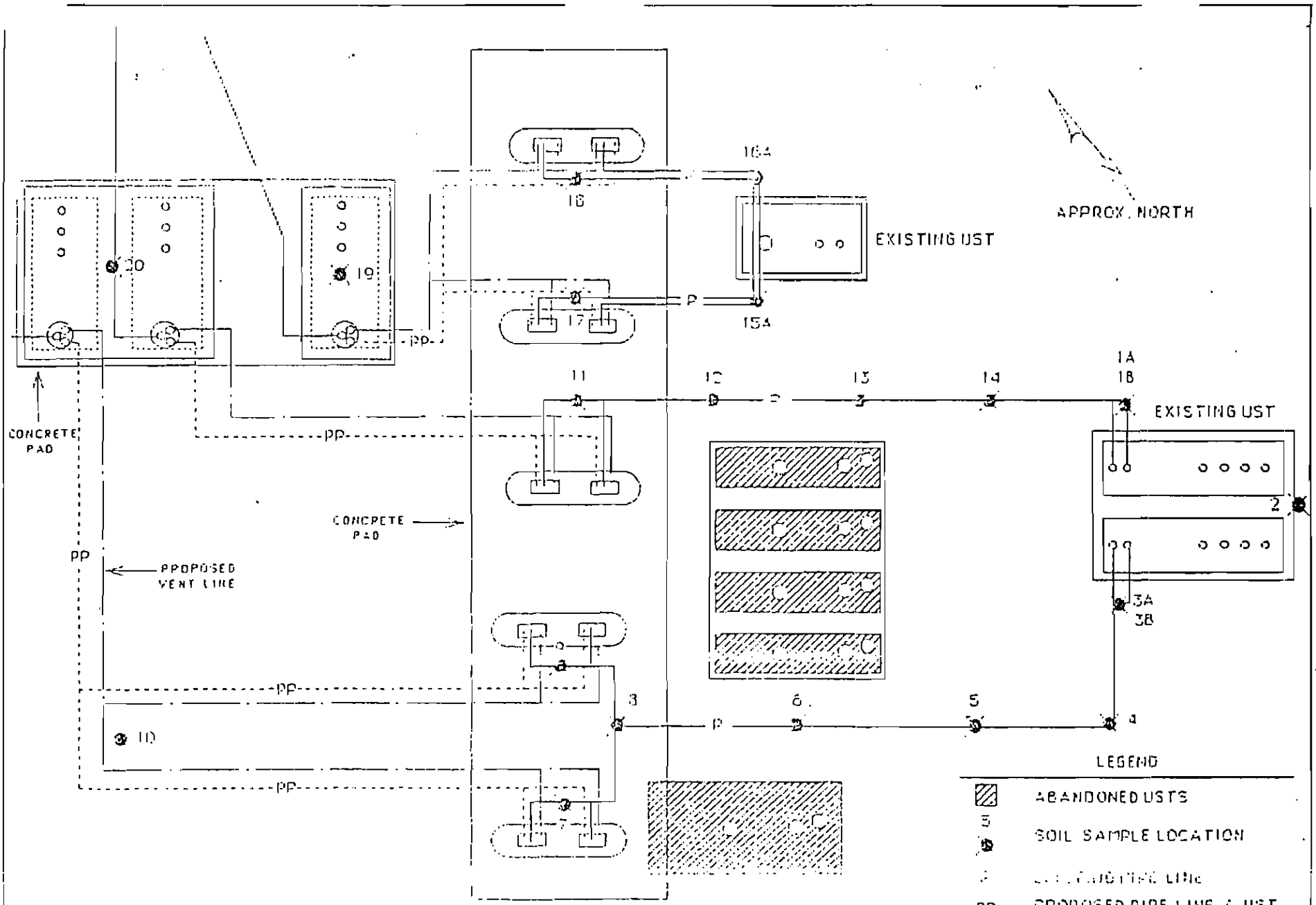
1.0 INTRODUCTION

The study site is identified as Building #1346 at the Charleston Naval Base and is a retail automotive gasoline service station (Figure 1). The site presently possesses a total of 8 gasoline Underground Storage Tanks (USTs), 3 of which were recently operational. In 1978, four 1,000 gallon and one 10,000 gallon gasoline USTs were taken out of service and were abandoned in place. This involved internal cleaning of the tanks and filling with sand. The site was then fitted with three new gasoline USTs of 10,000 gallon capacity that have been operational until early 1991.

In February of 1991, the three 10,000 gallon gasoline USTs were tested for tightness. The results of the testing indicated that all three USTs were leaking and as a result they were immediately taken out of service. Presently, the site is scheduled to be fitted with three new USTs. These USTs and associated product piping will be located on the opposite side of the site relative to the existing USTs to minimize the amount of expected contaminated material encountered upon installation. A site plan depicting the various UST locations is presented as Figure 2.



SCALE: 1:24000	DRAWN BY: [illegible]	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29646 (803) 884-0005	TITLE: SITE PLAN BUILDING 1346 CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA
DATE: 3-18-91	CHECKED BY:		FIGURE 1
JOB NO: 1234-89-489	APPROVED BY:		



SCALE: 1" = 20'	DRAWN BY: GBM	Westinghouse Environmental and Geotechnical Services, Inc.	TITLE: SITE SAMPLING PLAN BUILDING 1346 CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA	FIGURE 2
DATE: 3-14-91	CHECKED BY: HSC			
JOB NO: [illegible]	APPROVED BY: HSC			

2.0 OBJECTIVE AND SCOPE OF WORK

Westinghouse was retained to provide soil sampling and analysis to assess the subsurface soils at the site that may have been impacted due to the leaking USTs and to aid in determining if the groundwater at the site may have been impacted.

In compliance with Section 280.72 of the South Carolina Underground Storage Tank Control Regulations, Westinghouse conducted a site assessment at Building #1346 of the Charleston Naval Base. This assessment was conducted in accordance with the South Carolina Department of Health and Environmental Control's (SCDHECs) Underground Storage Tank Abandonment/Assessment Guidelines dated December 5, 1990, requiring that soil samples be collected within the tank basins and at 20' intervals along product piping runs.

2.1 Site Inspection/Sampling and Laboratory Analyses

On February 25, 1991, Westinghouse personnel arrived on site to mark the sample locations and perform a visual inspection of the site. No apparent problem areas were noted during the inspection and the UST fill locations, dispenser islands and vent lines did not visibly indicate the presence of a release.

Plans provided by the Charleston Naval Base were utilized to approximate the locations of the product piping. The exact locations were then determined by utilizing a hand held metal detector. A total of 20 sample locations were marked at the site. Sample numbers 1B, 2 and 3B were intended to be lower level samples collected from the bottom of the tank basin; however, groundwater was encountered in these areas at a depth of 5 feet below grade and the samples were therefore collected at this depth.

The remaining samples were collected adjacent to product lines between the USTs and the retail issue points at a depth of 3 feet below grade. Lower level samples were to be collected from the base of the UST associated with sample numbers 15A and 16A; however, due to the shallow depth at which groundwater was encountered (3.5 feet below grade), the deeper samples were not collected.

Three additional soil samples were collected from the location of the proposed product piping and UST locations situated on the opposite side of the site from the existing USTs. This was performed to determine if the soils in the area of the proposed tanks and product piping were contaminated. Sample number 10 was collected from a proposed product piping area at a depth of 3 feet below grade . Sample numbers 19 and 20 were collected from the area of the proposed UST basins at a depth of 5 feet below grade (at the soil/groundwater interface).

One groundwater sample was to be collected from an open borehole at each of the existing USTs basins; however, borehole collapse at the soil groundwater interface would not permit the collection of these samples.

Prior to and in between each sample collected, the sampling equipment was decontaminated with a chemically neutral surfactant and was rinsed a minimum of three times with deionized water. Upon collection, the samples were labeled and immediately refrigerated. Once sample collection had been completed, all samples were shipped by overnight courier to Westinghouse's in-house Laboratory in Charlotte, North Carolina for analysis. All samples collected at the site were analyzed for Total Petroleum Hydrocarbons (TPH) by Gas Chromatography (GC), the EPA Method 602 constituents and total lead.

2.2 Laboratory Analysis Results

Lead was not detected in any of the soil samples collected from Building #1346; however varying levels of petroleum hydrocarbon contamination were detected in all samples. Table 1 summarizes the results of the laboratory analyses.

...LE 1

SUMMARY OF LABORATORY ANALYSES
BUILDING #1346 - CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

SAMPLE #	TPH BY GC (mg/kg)	EPA METHOD 602 CONSTITUENTS (µg/kg)							
		BENZENE	CHLORO-BENZENE	1, 2-DICHLORO-BENZENE	1, 3-DICHLORO BENZENE	1, 4-DICHLORO-BENZENE	ETHYLBENZENE	TOLUENE	XYLENE
NAVUST-1A	1210	11.6	339	428	65.2	33.3	156	198	2950
NAVUST-1B	217	1790	74.6	228	40.5	20.7	BQL*	658	5250
NAVUST-2	253	306	186	267	34.3	26.3	BQL	1880	4160
NAVUST-3A	455	16.1	153	378	42.2	33.9	1370	211	7010
NAVUST-3B	2250/93.6**	531	89.6	159	29.6	20.1	49.7	876	2030
NAVUST-4	114	210	36.7	312	55.8	46.9	BQL	4190	6000
NAVUST-5	1560	35.0	52.5	485	57.8	51.4	2040	355	5920
NAVUST-6	283	157	22.0	485	57.8	51.4	526	1040	3160
NAVUST-7	7280	1590	1190	268	50.1	34.3	BQL	174	6930
NAVUST-8	67.6	389	38.9	464	161	15.3	2120	132	475
NAVUST-9	55.1	3390	13.2	249	100	6.4	550	52.8	245
NAVUST-10	33.7	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
NAVUST-11	202	78.3	32.0	406	212	8.38	134	43.1	128
NAVUST-12	3720	161	77.1	89.1	19.0	12.9	BQL	754	7220
NAVUST-13	25.5	85.6	6.77	117	36.2	BQL	150	20.0	300
NAVUST-14	19.8	BQL	BQL	BQL	BQL	BQL	BQL	8.9	8.6
NAVUST-15A	5460	1880	193	134	35.9	25.7	BQL	3200	18.200
NAVUST-16A	3400/109	5750	36.4	114	19.0	15.6	BQL	11.500	1350
NAVUST-17	731	2690	24.6	513	273	13.5	BQL	735	1480
NAVUST-18	96.6	2580	13.7	396	150	18.5	2310	65.7	1360
NAVUST-19	30.5	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
NAVUST-20	38.3	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

NOTES: * BQL - INDICATES PARAMETER NOT DETECTED. ** - 3B AND 16A UNDERWENT ADDITIONAL ANALYSES FOR VOLATILE HYDROCARBONS FOR COMPARISON PURPOSES.

3.0 CONCLUSIONS/RECOMMENDATIONS

Various levels of petroleum hydrocarbon contamination were detected in all samples collected from Building #1346 at the Charleston Naval Base indicating that a significant release has occurred from the subject USTs. The laboratory results obtained indicate that this release has impacted the soils associated with the UST basins, product piping and retail issuing points. In addition to these areas, it has been found that contamination has migrated to the area of the proposed UST basin as was identified in sample numbers NAVUST-10, NAVUST-19 and NAVUST-20.

Westinghouse recommends the subject USTs that have failed to meet South Carolina State requirements for tank tightness testing be abandoned according to the SCDHEC regulations (either abandoned in place or removed). Any soil resulting from the abandonment of the USTs should be considered contaminated and should be stockpiled on-site, sampled and analyzed for petroleum related constituents to determine the proper method for disposal.

Based upon levels of contamination detected in sample numbers 1B, 3B, 15A and 16A (collected at the soil groundwater interface) it is probable that the groundwater in the areas has been impacted. This impact may or may not have migrated across and/or off of the gasoline service station site. With regard to the installation of the proposed USTs and pipelines at the site, the soil resulting from this operation should be considered to be contaminated. However, based upon the lower levels of contamination detected in the proposed tank basin and piping trenches, this material should be stockpiled separately, sampled and analyzed to determine the method for proper disposal. Based on the results identified in this assessment, it is probable that the soil excavated in the area of the new tanks will contain minimal contamination and will only require landfilling as opposed to incineration which is normally required for soils contaminated with TPH in excess of 100 mg/kg. Due to the fact that groundwater at the site has been impacted, any groundwater resulting from dewatering operations for the installation of the proposed USTs should be considered contaminated and should be handled appropriately.

In addition to the previous recommended work, Westinghouse recommends that a site characterization be performed to determine the horizontal and vertical extent of the probable groundwater impact. This would involve performing an extensive soil vapor survey across the site and the installation of groundwater monitoring wells to confirm the location of the dissolved product plume. Aquifer testing will also be required to determine the hydraulic aquifer characteristics. This information could then be utilized to design a groundwater recovery system for site remediation.

APPENDIX I

LABORATORY ANALYSIS DATA SHEETS

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
P.O. Box 7668
Charlotte, North Carolina 28241-7668
(704) 523-4726
FAX (704) 525-3953

Lead, Total in Soil

Westinghouse Environmental Job No: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484)

Date Analyzed: 3/5/91 Analyst: Ty Garber

Sample I.D.	Quant. Limit. mg/kg	Results mg/kg
NAVUST-1A	5.0	BQL
NAVUST-1B	5.0	BQL
NAVUST-2	5.0	BQL
NAVUST-3A	5.0	BQL
NAVUST-3B	5.0	BQL
NAVUST-4	5.0	BQL
NAVUST-5	5.0	BQL
NAVUST-6	5.0	BQL
NAVUST-7	5.0	BQL
NAVUST-8	5.0	BQL
NAVUST-9	5.0	BQL
NAVUST-10	5.0	BQL
NAVUST-11	5.0	BQL
NAVUST-12	5.0	BQL
NAVUST-13	5.0	BQL
NAVUST-14	5.0	BQL
NAVUST-15A	5.0	BQL
NAVUST-16A	5.0	BQL
NAVUST-17	5.0	BQL
NAVUST-18	5.0	BQL
NAVUST-19	5.0	BQL
NAVUST-20	5.0	BQL

Comments: EPA SW-846 Method 3050 used in digestion. Samples analyzed by flame AA.

BQL = Below Quantitation Limit

QA/QC Supervisor: _____ Date: 3/7/91

N.C. Wastewater #321, S.C.D.H.E.D. #99033

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
P.O. Box 7668
Charlotte, North Carolina 28241-7668
(704) 523-4726
FAX (704) 525-3953

Total Petroleum Hydrocarbons

Westinghouse Job No.: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484)

Date Analyzed: 3/5/91 By: Ty Garber

	Semi-Volatiles		Volatiles	
Sample ID	Quant. Limit mg/kg	Results mg/kg	Quant. Limit mg/kg	Results mg/kg
NAVUST-1A	10.0	1,210	0.1	N/A
NAVUST-1B	10.0	217	0.1	N/A
NAVUST-2	10.0	253	0.1	N/A
NAVUST-3A	10.0	455	0.1	N/A
NAVUST-3B	10.0	2,250	0.1	93.6
NAVUST-4	10.0	114	0.1	N/A
NAVUST-5	10.0	1,560	0.1	N/A
NAVUST-6	10.0	283	0.1	N/A
NAVUST-7	10.0	7,280	0.1	N/A
NAVUST-8	10.0	67.6	0.1	N/A
NAVUST-9	10.0	55.1	0.1	N/A
NAVUST-10	10.0	33.7	0.1	N/A
NAVUST-11	10.0	202	0.1	N/A
NAVUST-12	10.0	3,720	0.1	N/A
NAVUST-13	10.0	25.5	0.1	N/A
NAVUST-14	10.0	19.8	0.1	N/A
NAVUST-15A	10.0	5,460	0.1	N/A
NAVUST-16A	10.0	3,400	0.1	109
NAVUST-17	10.0	731	0.1	N/A
NAVUST-18	10.0	96.6	0.1	N/A
NAVUST-19	10.0	30.5	0.1	N/A
NAVUST-20	10.0	38.3	0.1	N/A

Comments:

Semi-Volatile analysis: Extraction (SW-846, Method 3550); results expressed as mg diesel fuel per kg soil. Components exhibit characteristics similar to gasoline.

Volatile analysis: Purge and Trap (SW-846, Method 5030); results expressed as mg gasoline per kg soil.

BQL = Below Quantitation Limit N/A = Not Applicable

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
P.O. Box 7668
Charlotte, North Carolina 28241-7668
(704) 523-4726
FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-454) NAVUST-1A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	11.6
2	Chlorobenzene	5.0	339
3	1,2-Dichlorobenzene	5.0	428
4	1,3-Dichlorobenzene	5.0	65.2
5	1,4-Dichlorobenzene	5.0	33.3
6	Ethylbenzene	5.0	156
7	Toluene	5.0	198
8	Total Xylenes	5.0	2950

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-1B

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1790
2	Chlorobenzene	5.0	74.6
3	1,2-Dichlorobenzene	5.0	228
4	1,3-Dichlorobenzene	5.0	40.5
5	1,4-Dichlorobenzene	5.0	20.7
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	658
8	Total Xylenes	5.0	3250

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-2

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	306
2	Chlorobenzene	5.0	186
3	1,2-Dichlorobenzene	5.0	267
4	1,3-Dichlorobenzene	5.0	34.3
5	1,4-Dichlorobenzene	5.0	26.3
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	1880
8	Total Xylenes	5.0	4160

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-3A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	16.1
2	Chlorobenzene	5.0	153
3	1,2-Dichlorobenzene	5.0	378
4	1,3-Dichlorobenzene	5.0	42.2
5	1,4-Dichlorobenzene	5.0	33.9
6	Ethylbenzene	5.0	1370
7	Toluene	5.0	211
8	Total Xylenes	5.0	7010

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-3B

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	531
2	Chlorobenzene	5.0	89.6
3	1,2-Dichlorobenzene	5.0	159
4	1,3-Dichlorobenzene	5.0	29.6
5	1,4-Dichlorobenzene	5.0	30.1
6	Ethylbenzene	5.0	49.7
7	Toluene	5.0	876
8	Total Xylenes	5.0	2030

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-4

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	210
2	Chlorobenzene	5.0	36.7
3	1,2-Dichlorobenzene	5.0	312
4	1,3-Dichlorobenzene	5.0	55.8
5	1,4-Dichlorobenzene	5.0	46.9
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	4190
8	Total Xylenes	5.0	6000

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-5

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	35.0
2	Chlorobenzene	5.0	52.5
3	1,2-Dichlorobenzene	5.0	485
4	1,3-Dichlorobenzene	5.0	57.8
5	1,4-Dichlorobenzene	5.0	51.4
6	Ethylbenzene	5.0	2040
7	Toluene	5.0	355
8	Total Xylenes	5.0	5910

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-6

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	157
2	Chlorobenzene	5.0	22.0
3	1,2-Dichlorobenzene	5.0	485
4	1,3-Dichlorobenzene	5.0	57.6
5	1,4-Dichlorobenzene	5.0	51.4
6	Ethylbenzene	5.0	526
7	Toluene	5.0	1040
8	Total Xylenes	5.0	3160

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-7

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1590
2	Chlorobenzene	5.0	1190
3	1,2-Dichlorobenzene	5.0	268
4	1,3-Dichlorobenzene	5.0	50.1
5	1,4-Dichlorobenzene	5.0	34.3
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	174
8	Total Xylenes	5.0	6930

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-8

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	389
2	Chlorobenzene	5.0	38.9
3	1,2-Dichlorobenzene	5.0	464
4	1,3-Dichlorobenzene	5.0	161
5	1,4-Dichlorobenzene	5.0	15.3
6	Ethylbenzene	5.0	2120
7	Toluene	5.0	132
8	Total Xylenes	5.0	475

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-9

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	3390
2	Chlorobenzene	5.0	13.2
3	1,2-Dichlorobenzene	5.0	249
4	1,3-Dichlorobenzene	5.0	100
5	1,4-Dichlorobenzene	5.0	6.43
6	Ethylbenzene	5.0	550
7	Toluene	5.0	52.8
8	Total Xylenes	5.0	245

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-10

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-11

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	78.3
2	Chlorobenzene	5.0	32.0
3	1,2-Dichlorobenzene	5.0	406
4	1,3-Dichlorobenzene	5.0	212
5	1,4-Dichlorobenzene	5.0	8.38
6	Ethylbenzene	5.0	134
7	Toluene	5.0	43.1
8	Total Xylenes	5.0	128

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-12

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	161
2	Chlorobenzene	5.0	77.1
3	1,2-Dichlorobenzene	5.0	69.1
4	1,3-Dichlorobenzene	5.0	19.0
5	1,4-Dichlorobenzene	5.0	12.9
6	Ethylbenzene	5.0	BDL
7	Toluene	5.0	754
8	Total Xylenes	5.0	7220

Comments: BDL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-13

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	85.6
2	Chlorobenzene	5.0	6.77
3	1,2-Dichlorobenzene	5.0	117
4	1,3-Dichlorobenzene	5.0	36.2
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	150
7	Toluene	5.0	20.0
8	Total Xylenes	5.0	300

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-14

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	8.90
8	Total Xylenes	5.0	8.61

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-15A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1880
2	Chlorobenzene	5.0	193
3	1,2-Dichlorobenzene	5.0	134
4	1,3-Dichlorobenzene	5.0	35.9
5	1,4-Dichlorobenzene	5.0	25.7
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	3200
8	Total Xylenes	5.0	18,200

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-16A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	5750
2	Chlorobenzene	5.0	36.4
3	1,2-Dichlorobenzene	5.0	114
4	1,3-Dichlorobenzene	5.0	19.0
5	1,4-Dichlorobenzene	5.0	15.6
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	11,500
8	Total Xylenes	5.0	1350

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-17

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	2690
2	Chlorobenzene	5.0	24.6
3	1,2-Dichlorobenzene	5.0	513
4	1,3-Dichlorobenzene	5.0	273
5	1,4-Dichlorobenzene	5.0	13.5
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	735
8	Total Xylenes	5.0	1480

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-16

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	2580
2	Chlorobenzene	5.0	13.7
3	1,2-Dichlorobenzene	5.0	396
4	1,3-Dichlorobenzene	5.0	150
5	1,4-Dichlorobenzene	5.0	18.5
6	Ethylbenzene	5.0	2310
7	Toluene	5.0	65.7
8	Total Xylenes	5.0	1360

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-19

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-20

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

APPENDIX III

SCWRC WATER WELL DATA

SOUTH CAROLINA WATER RESOURCES COMMISSION WATER WELL REPORT FORM GW-1

SCWRC#: 18CC-q01 Print Date: 06/29/199

HEADER INFO

SCWRC #: 18CC-q01 County Well #: CHN-0476
WRC User ID: Owner's Well Name:
11 Location: CNSY Powerhouse Basin: 03050201
Quad. Name: Charleston Quad #: 089
Latitude: 325143 Longitude: 795811 North UTM: 3636168 East UTM: 596378
Land Surface Elevation (ft): 20.00 Elev. Method: T Topography: FLAT

Owner: US Naval Shipyard Contact: Norman Moore
Address: City: State: Zip:
Contact's Phone: 803-743-3135

Aquifer: Water Use: IN Water Source: W Well Yield: -1
Depth Drilled (ft): 315 Depth Completed (ft): -1
Construction Data: Chemical Analysis: Geophysical Logs: Y
Pumping Test: Water Level Data: Y Class-A Well:

Remarks: Well is capped (5/26/89).

LOG DATA

Cores		Lateral		Natural Gamma	P	Fluid res/cond	
Cuttings		Single Point		Gamma-Gamma		Temperature	
Sieve Analysis		Spon. Poten.		Neutron		Flow Meter	
Driller's Log		Short Normal		Long Normal		Acoustic	
Geologist's Log		Caliper	P			Other	

Code: P = Paper D = Digital B = Both

WELL MONITORING DATA

WATER LEVEL
ADR From: / / To: / /
OBSERVATION From: 03/31/1981 To: / /

WATER QUALITY
CHLORIDE From: / / To: / /
OTHER From: / / To: / /

Screens - Casings - Water Levels

CASINGS:

CASE#	TYPE	DIA	TOP	BOT	CASE#	TYPE	DIA	TOP	BOT

SCREENS:

SCRN#	TYPE	DIA	TOP	BOT	SLT	SCRN#	TYPE	DIA	TOP	BOT	SLT

WATER LEVELS:

Date	Time	Land Surf.	Mean Sea Lvl	Method	By
09/17/1989	1400	-52.50	-32.50	TAPE	SCWR

CLOSURE ASSESSMENT REPORT
RETAIL FUEL DISTRIBUTION FACILITY
BUILDING #1346
CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

Prepared for:

The LPA Group of North Carolina
38303 B Computer Drive, Suite 204
Raleigh, North Carolina 27619

Prepared by:

Westinghouse Environmental
and Geotechnical Services, Inc.
840 Low Country Boulevard
Mount Pleasant, South Carolina 29464
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March 26, 1991

The LPA Group of North Carolina
3803 B Computer Drive, Suite 204
Raleigh, North Carolina 27619

Attention: Mr. Gary Green

Subject: Closure Assessment Report
Building #1346, Charleston Naval Base
Charleston, South Carolina
Westinghouse Environmental and Geotechnical Services, Inc.
Job #CSWA079

Dear Mr. Green:

Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) is pleased to submit the enclosed Closure Assessment Report for the retail fuel distribution facility, Building #1346 located at the Charleston Naval Base in Charleston, South Carolina. This report is provided in general accordance with our proposal number 340-91-024 dated February 20, 1991. The following report describes our sampling methodology, the analytical results and our conclusions and recommendations.

If you have any questions concerning this report or if you require any additional information, please contact Hugh Connolly at (803) 884-0005.

Sincerely,

WESTINGHOUSE ENVIRONMENTAL
AND GEOTECHNICAL SERVICES, INC.

Hugh Connolly
Project Hydrogeologist

Sonny Chestnut, P.E.
Senior Environmental Engineer

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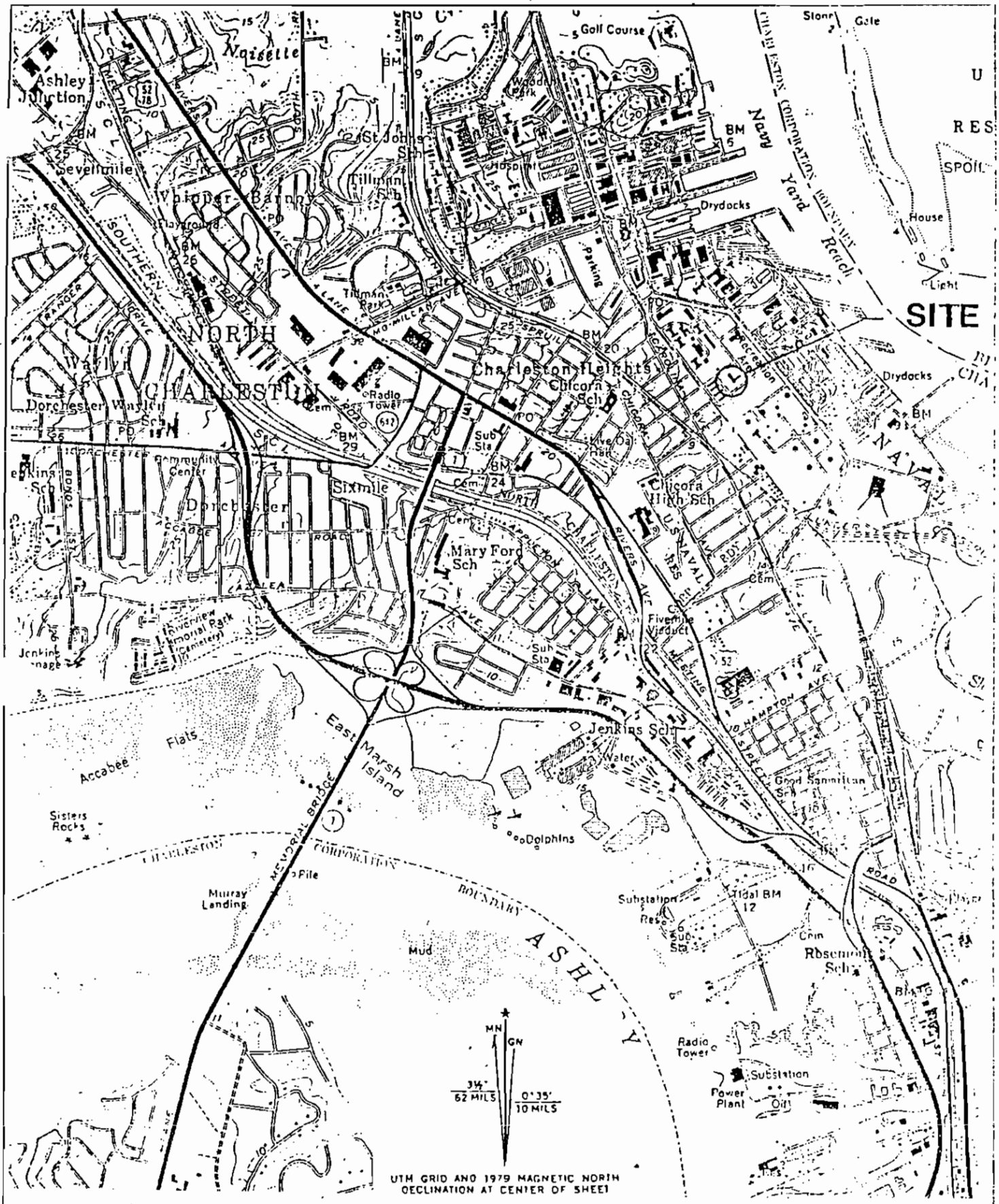
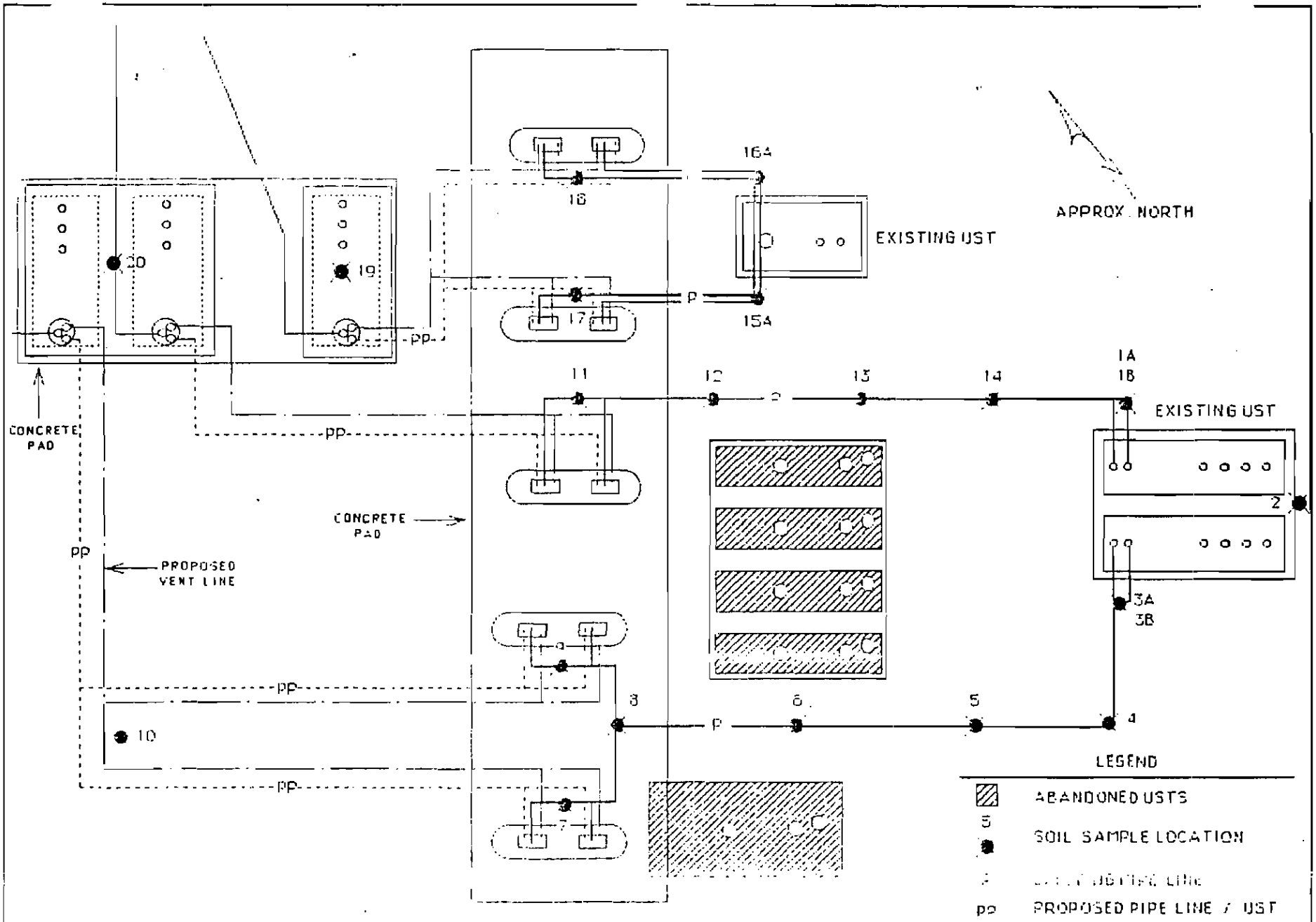
1.0 INTRODUCTION

The study site is identified as Building #1346 at the Charleston Naval Base and is a retail automotive gasoline service station (Figure 1). The site presently possesses a total of 8 gasoline Underground Storage Tanks (USTs), 3 of which were recently operational. In 1978, four 1,000 gallon and one 10,000 gallon gasoline USTs were taken out of service and were abandoned in place. This involved internal cleaning of the tanks and filling with sand. The site was then fitted with three new gasoline USTs of 10,000 gallon capacity that have been operational until early 1991.

In February of 1991, the three 10,000 gallon gasoline USTs were tested for tightness. The results of the testing indicated that all three USTs were leaking and as a result they were immediately taken out of service. Presently, the site is scheduled to be fitted with three new USTs. These USTs and associated product piping will be located on the opposite side of the site relative to the existing USTs to minimize the amount of expected contaminated material encountered upon installation. A site plan depicting the various UST locations is presented as Figure 2.



SCALE: 1:24000	DRAWN BY: GKM	Westinghouse Environmental and Geotechnical Services, Inc. 840 Low Country Boulevard Mt. Pleasant, South Carolina 29646 (803) 884-0005	TITLE: SITE PLAN BUILDING 1346 CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA
DATE: 3-18-91	CHECKED BY:		FIGURE 1
JOB NO: 1234-89-489	APPROVED BY:		



SCALE: 1" = 20'	DRAWN BY: GRM	Westinghouse Environmental and Geotechnical Services, Inc.	TITLE: SITE SAMPLING PLAN BUILDING 1346 CHARLESTON NAVAL BASE CHARLESTON, SOUTH CAROLINA
DATE: 3-19-91	CHECKED BY: HSC		
JOB NO: [illegible]	APPROVED BY: HSC		FIGURE 2

2.0 OBJECTIVE AND SCOPE OF WORK

Westinghouse was retained to provide soil sampling and analysis to assess the subsurface soils at the site that may have been impacted due to the leaking USTs and to aid in determining if the groundwater at the site may have been impacted.

In compliance with Section 280.72 of the South Carolina Underground Storage Tank Control Regulations, Westinghouse conducted a site assessment at Building #1346 of the Charleston Naval Base. This assessment was conducted in accordance with the South Carolina Department of Health and Environmental Control's (SCDHECs) Underground Storage Tank Abandonment/Assessment Guidelines dated December 5, 1990, requiring that soil samples be collected within the tank basins and at 20' intervals along product piping runs.

2.1 Site Inspection/Sampling and Laboratory Analyses

On February 25, 1991, Westinghouse personnel arrived on site to mark the sample locations and perform a visual inspection of the site. No apparent problem areas were noted during the inspection and the UST fill locations, dispenser islands and vent lines did not visibly indicate the presence of a release.

Plans provided by the Charleston Naval Base were utilized to approximate the locations of the product piping. The exact locations were then determined by utilizing a hand held metal detector. A total of 20 sample locations were marked at the site. Sample numbers 1B, 2 and 3B were intended to be lower level samples collected from the bottom of the tank basin; however, groundwater was encountered in these areas at a depth of 5 feet below grade and the samples were therefore collected at this depth.

The remaining samples were collected adjacent to product lines between the USTs and the retail issue points at a depth of 3 feet below grade. Lower level samples were to be collected from the base of the UST associated with sample numbers 15A and 16A; however, due to the shallow depth at which groundwater was encountered (3.5 feet below grade), the deeper samples were not collected.

Three additional soil samples were collected from the location of the proposed product piping and UST locations situated on the opposite side of the site from the existing USTs. This was performed to determine if the soils in the area of the proposed tanks and product piping were contaminated. Sample number 10 was collected from a proposed product piping area at a depth of 3 feet below grade . Sample numbers 19 and 20 were collected from the area of the proposed UST basins at a depth of 5 feet below grade (at the soil/groundwater interface).

One groundwater sample was to be collected from an open borehole at each of the existing USTs basins; however, borehole collapse at the soil groundwater interface would not permit the collection of these samples.

Prior to and in between each sample collected, the sampling equipment was decontaminated with a chemically neutral surfactant and was rinsed a minimum of three times with deionized water. Upon collection, the samples were labeled and immediately refrigerated. Once sample collection had been completed, all samples were shipped by overnight courier to Westinghouse's in-house Laboratory in Charlotte, North Carolina for analysis. All samples collected at the site were analyzed for Total Petroleum Hydrocarbons (TPH) by Gas Chromatography (GC), the EPA Method 602 constituents and total lead.

2.2 Laboratory Analysis Results

Lead was not detected in any of the soil samples collected from Building #1346; however varying levels of petroleum hydrocarbon contamination were detected in all samples. Table 1 summarizes the results of the laboratory analyses.

SUMMARY OF LABORATORY ANALYSES
BUILDING #1346 - CHARLESTON NAVAL BASE
CHARLESTON, SOUTH CAROLINA

SAMPLE #	TPH BY GC (mg/kg)	EPA METHOD 602 CONSTITUENTS (µg/kg)							
		BENZENE	CHLORO-BENZENE	1, 2-DICHLORO-BENZENE	1, 3-DICHLORO BENZENE	1, 4-DICHLORO-BENZENE	ETHYLBENZENE	TOLUENE	XYLENE
NAVUST-1A	1210	11.6	339	428	65.2	33.3	156	198	2950
NAVUST-1B	217	1790	74.6	228	40.5	20.7	BQL*	658	5250
NAVUST-2	253	306	186	267	34.3	26.3	BQL	1880	4160
NAVUST-3A	455	16.1	153	378	42.2	33.9	1370	211	7010
NAVUST-3B	2250/93.6**	531	89.6	159	29.6	20.1	49.7	876	2030
NAVUST-4	114	210	36.7	312	55.8	46.9	BQL	4190	6000
NAVUST-5	1560	35.0	52.5	485	57.8	51.4	2040	355	5920
NAVUST-6	283	157	22.0	485	57.8	51.4	526	1040	3160
NAVUST-7	7280	1590	1190	268	50.1	34.3	BQL	174	6930
NAVUST-8	67.6	389	38.9	464	161	15.3	2120	132	475
NAVUST-9	55.1	3390	13.2	249	100	6.4	550	52.8	245
NAVUST-10	33.7	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
NAVUST-11	202	78.3	32.0	406	212	8.38	134	43.1	128
NAVUST-12	3720	161	77.1	89.1	19.0	12.9	BQL	754	7220
NAVUST-13	25.5	85.6	6.77	117	36.2	BQL	150	20.0	300
NAVUST-14	19.8	BQL	BQL	BQL	BQL	BQL	BQL	8.9	8.6
NAVUST-15A	5460	1880	193	134	35.9	25.7	BQL	3200	18,200
NAVUST-16A	3400/109	5750	36.4	114	19.0	15.6	BQL	11.500	1350
NAVUST-17	731	2690	24.6	513	273	13.5	BQL	735	1480
NAVUST-18	96.6	2580	13.7	396	150	18.5	2310	65.7	1360
NAVUST-19	30.5	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
NAVUST-20	38.3	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

NOTES: * BQL - INDICATES PARAMETER NOT DETECTED. ** - 3B AND 16A UNDERWENT ADDITIONAL ANALYSES FOR VOLATILE HYDROCARBONS FOR COMPARISON PURPOSES.

3.0 CONCLUSIONS/RECOMMENDATIONS

Various levels of petroleum hydrocarbon contamination were detected in all samples collected from Building #1346 at the Charleston Naval Base indicating that a significant release has occurred from the subject USTs. The laboratory results obtained indicate that this release has impacted the soils associated with the UST basins, product piping and retail issuing points. In addition to these areas, it has been found that contamination has migrated to the area of the proposed UST basin as was identified in sample numbers NAVUST-10, NAVUST-19 and NAVUST-20.

Westinghouse recommends the subject USTs that have failed to meet South Carolina State requirements for tank tightness testing be abandoned according to the SCDHEC regulations (either abandoned in place or removed). Any soil resulting from the abandonment of the USTs should be considered contaminated and should be stockpiled on-site, sampled and analyzed for petroleum related constituents to determine the proper method for disposal.

Based upon levels of contamination detected in sample numbers 1B, 3B, 15A and 16A (collected at the soil groundwater interface) it is probable that the groundwater in the areas has been impacted. This impact may or may not have migrated across and/or off of the gasoline service station site. With regard to the installation of the proposed USTs and pipelines at the site, the soil resulting from this operation should be considered to be contaminated. However, based upon the lower levels of contamination detected in the proposed tank basin and piping trenches, this material should be stockpiled separately, sampled and analyzed to determine the method for proper disposal. Based on the results identified in this assessment, it is probable that the soil excavated in the area of the new tanks will contain minimal contamination and will only require landfilling as opposed to incineration which is normally required for soils contaminated with TPH in excess of 100 mg/kg. Due to the fact that groundwater at the site has been impacted, any groundwater resulting from dewatering operations for the installation of the proposed USTs should be considered contaminated and should be handled appropriately.

In addition to the previous recommended work, Westinghouse recommends that a site characterization be performed to determine the horizontal and vertical extent of the probable groundwater impact. This would involve performing an extensive soil vapor survey across the site and the installation of groundwater monitoring wells to confirm the location of the dissolved product plume. Aquifer testing will also be required to determine the hydraulic aquifer characteristics. This information could then be utilized to design a groundwater recovery system for site remediation.

APPENDIX I

LABORATORY ANALYSIS DATA SHEETS

Westinghouse Environmental
and Geotechnical Services, Inc.

9751 Southern Pine Boulevard
Charlotte, North Carolina 28273
P.O. Box 7668
Charlotte, North Carolina 28241-7668
(704) 523-4726
FAX (704) 525-3953

Lead, Total in Soil

Westinghouse Environmental Job No: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484)

Date Analyzed: 3/5/91 Analyst: Ty Garber

Sample I.D.	Quant. Limit. mg/kg	Results mg/kg
NAVUST-1A	5.0	BQL
NAVUST-1B	5.0	BQL
NAVUST-2	5.0	BQL
NAVUST-3A	5.0	BQL
NAVUST-3B	5.0	BQL
NAVUST-4	5.0	BQL
NAVUST-5	5.0	BQL
NAVUST-6	5.0	BQL
NAVUST-7	5.0	BQL
NAVUST-8	5.0	BQL
NAVUST-9	5.0	BQL
NAVUST-10	5.0	BQL
NAVUST-11	5.0	BQL
NAVUST-12	5.0	BQL
NAVUST-13	5.0	BQL
NAVUST-14	5.0	BQL
NAVUST-15A	5.0	BQL
NAVUST-16A	5.0	BQL
NAVUST-17	5.0	BQL
NAVUST-18	5.0	BQL
NAVUST-19	5.0	BQL
NAVUST-20	5.0	BQL

Comments: EPA SW-846 Method 3050 used in digestion. Samples analyzed by flame AA.

BQL = Below Quantitation Limit

QA/QC Supervisor: _____ Date: 3/7/91

N.C. Wastewater #321, S.C.D.H.E.D. #99033

Westinghouse Environmental
and Geotechnical Services, Inc.

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(704) 523-4726
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Total Petroleum Hydrocarbons

Westinghouse Job No.: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484)

Date Analyzed: 3/5/91 By: Ty Garber

	Semi-Volatiles		Volatiles	
Sample ID	Quant. Limit mg/kg	Results mg/kg	Quant. Limit mg/kg	Results mg/kg
NAVUST-1A	10.0	1,210	0.1	N/A
NAVUST-1B	10.0	217	0.1	N/A
NAVUST-2	10.0	253	0.1	N/A
NAVUST-3A	10.0	455	0.1	N/A
NAVUST-3B	10.0	2,250	0.1	93.6
NAVUST-4	10.0	114	0.1	N/A
NAVUST-5	10.0	1,560	0.1	N/A
NAVUST-6	10.0	283	0.1	N/A
NAVUST-7	10.0	7,280	0.1	N/A
NAVUST-8	10.0	67.6	0.1	N/A
NAVUST-9	10.0	55.1	0.1	N/A
NAVUST-10	10.0	33.7	0.1	N/A
NAVUST-11	10.0	202	0.1	N/A
NAVUST-12	10.0	3,720	0.1	N/A
NAVUST-13	10.0	25.5	0.1	N/A
NAVUST-14	10.0	19.8	0.1	N/A
NAVUST-15A	10.0	5,460	0.1	N/A
NAVUST-16A	10.0	3,400	0.1	109
NAVUST-17	10.0	731	0.1	N/A
NAVUST-18	10.0	96.6	0.1	N/A
NAVUST-19	10.0	30.5	0.1	N/A
NAVUST-20	10.0	38.3	0.1	N/A

Comments:

Semi-Volatile analysis: Extraction (SW-846, Method 3550); results expressed as mg diesel fuel per kg soil. Components exhibit characteristics similar to gasoline.

Volatile analysis: Purge and Trap (SW-846, Method 5030); results expressed as mg gasoline per kg soil.

BQL = Below Quantitation Limit N/A = Not Applicable

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-1A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	11.6
2	Chlorobenzene	5.0	339
3	1,2-Dichlorobenzene	5.0	428
4	1,3-Dichlorobenzene	5.0	65.2
5	1,4-Dichlorobenzene	5.0	33.3
6	Ethylbenzene	5.0	156
7	Toluene	5.0	198
8	Total Xylenes	5.0	2950

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-1B

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1790
2	Chlorobenzene	5.0	74.6
3	1,2-Dichlorobenzene	5.0	228
4	1,3-Dichlorobenzene	5.0	40.5
5	1,4-Dichlorobenzene	5.0	20.7
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	638
8	Total Xylenes	5.0	5250

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-2

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	306
2	Chlorobenzene	5.0	186
3	1,2-Dichlorobenzene	5.0	267
4	1,3-Dichlorobenzene	5.0	34.3
5	1,4-Dichlorobenzene	5.0	26.3
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	1880
8	Total Xylenes	5.0	4180

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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FAX (704) 525-3953

Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-3A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	16.1
2	Chlorobenzene	5.0	153
3	1,2-Dichlorobenzene	5.0	378
4	1,3-Dichlorobenzene	5.0	42.2
5	1,4-Dichlorobenzene	5.0	33.9
6	Ethylbenzene	5.0	1370
7	Toluene	5.0	211
8	Total Xylenes	5.0	7010

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-3B

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	531
2	Chlorobenzene	5.0	89.6
3	1,2-Dichlorobenzene	5.0	159
4	1,3-Dichlorobenzene	5.0	29.6
5	1,4-Dichlorobenzene	5.0	20.1
6	Ethylbenzene	5.0	49.7
7	Toluene	5.0	876
8	Total Xylenes	5.0	2030

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-4

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	210
2	Chlorobenzene	5.0	36.7
3	1,2-Dichlorobenzene	5.0	312
4	1,3-Dichlorobenzene	5.0	55.8
5	1,4-Dichlorobenzene	5.0	46.9
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	4190
8	Total Xylenes	5.0	6000

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-5

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	35.0
2	Chlorobenzene	5.0	52.5
3	1,2-Dichlorobenzene	5.0	485
4	1,3-Dichlorobenzene	5.0	57.8
5	1,4-Dichlorobenzene	5.0	51.4
6	Ethylbenzene	5.0	2040
7	Toluene	5.0	355
8	Total Xylenes	5.0	5920

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-6

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	157
2	Chlorobenzene	5.0	22.0
3	1,2-Dichlorobenzene	5.0	485
4	1,3-Dichlorobenzene	5.0	57.8
5	1,4-Dichlorobenzene	5.0	51.4
6	Ethylbenzene	5.0	526
7	Toluene	5.0	1040
8	Total Xylenes	5.0	3160

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-7

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1590
2	Chlorobenzene	5.0	1190
3	1,2-Dichlorobenzene	5.0	268
4	1,3-Dichlorobenzene	5.0	50.1
5	1,4-Dichlorobenzene	5.0	34.3
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	174
8	Total Xylenes	5.0	6930

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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and Geotechnical Services, Inc.

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-8

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	389
2	Chlorobenzene	5.0	38.9
3	1,2-Dichlorobenzene	5.0	464
4	1,3-Dichlorobenzene	5.0	161
5	1,4-Dichlorobenzene	5.0	15.3
6	Ethylbenzene	5.0	2120
7	Toluene	5.0	132
8	Total Xylenes	5.0	475

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

N.C. State Wastewater #321, S.C.D.H.E.C. #99033

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-9

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	3390
2	Chlorobenzene	5.0	13.2
3	1,2-Dichlorobenzene	5.0	249
4	1,3-Dichlorobenzene	5.0	100
5	1,4-Dichlorobenzene	5.0	6.43
6	Ethylbenzene	5.0	550
7	Toluene	5.0	52.8
8	Total Xylenes	5.0	245

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-10

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3,7,91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-11

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	78.3
2	Chlorobenzene	5.0	32.0
3	1,2-Dichlorobenzene	5.0	406
4	1,3-Dichlorobenzene	5.0	212
5	1,4-Dichlorobenzene	5.0	8.38
6	Ethylbenzene	5.0	134
7	Toluene	5.0	43.1
8	Total Xylenes	5.0	128

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-12

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	161
2	Chlorobenzene	5.0	77.1
3	1,2-Dichlorobenzene	5.0	89.1
4	1,3-Dichlorobenzene	5.0	19.0
5	1,4-Dichlorobenzene	5.0	12.9
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	754
8	Total Xylenes	5.0	7220

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-13

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	85.6
2	Chlorobenzene	5.0	6.77
3	1,2-Dichlorobenzene	5.0	117
4	1,3-Dichlorobenzene	5.0	36.2
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	150
7	Toluene	5.0	20.0
8	Total Xylenes	5.0	300

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-14

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	8.90
8	Total Xylenes	5.0	8.61

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-15A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	1880
2	Chlorobenzene	5.0	193
3	1,2-Dichlorobenzene	5.0	134
4	1,3-Dichlorobenzene	5.0	35.9
5	1,4-Dichlorobenzene	5.0	25.7
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	3200
8	Total Xylenes	5.0	18,200

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-16A

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	5750
2	Chlorobenzene	5.0	36.4
3	1,2-Dichlorobenzene	5.0	114
4	1,3-Dichlorobenzene	5.0	19.0
5	1,4-Dichlorobenzene	5.0	15.6
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	11,500
8	Total Xylenes	5.0	1350

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-17

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	2690
2	Chlorobenzene	5.0	24.6
3	1,2-Dichlorobenzene	5.0	513
4	1,3-Dichlorobenzene	5.0	273
5	1,4-Dichlorobenzene	5.0	13.5
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	735
8	Total Xylenes	5.0	1480

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-18

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	2580
2	Chlorobenzene	5.0	13.7
3	1,2-Dichlorobenzene	5.0	396
4	1,3-Dichlorobenzene	5.0	150
5	1,4-Dichlorobenzene	5.0	18.5
6	Ethylbenzene	5.0	2310
7	Toluene	5.0	65.7
8	Total Xylenes	5.0	1360

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-19

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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Purgeable Aromatics
EPA Method 8020 Compounds

Westinghouse Environmental Job Number: 1357-91-1100

Sample Identification: Naval Base UST (1234-89-484) NAVUST-20

Date Analyzed: 3/4/91 By: Stephanie Davis

Number	Compound	Quant. Limit ug/kg	Results Concentration ug/kg
1	Benzene	5.0	BQL
2	Chlorobenzene	5.0	BQL
3	1,2-Dichlorobenzene	5.0	BQL
4	1,3-Dichlorobenzene	5.0	BQL
5	1,4-Dichlorobenzene	5.0	BQL
6	Ethylbenzene	5.0	BQL
7	Toluene	5.0	BQL
8	Total Xylenes	5.0	BQL

Comments: BQL = Below Quantitation Limits

QA/QC Supervisor: _____ Date: 3/7/91

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